Information, risk perception and consumer behaviour

a choice experiment on food safety and animal welfare

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- a choice experiment on food safety and animal welfare

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Preface

The motivation for the present report is to understand consumer risk perception and food choice in relation to food-related health risks. In particular, a choice experiment is performed to elicit consumers' willingness to pay for food safety and animal welfare. Expert information is provided as an integrated part of the experiments in order to understand how information affects preferences and choices. The report is part of the research project "Information, Risk perception and Consumer behaviour" financed by the Danish Research Agency under a FELFO programme focusing on food research.

The report is the result of a cross-disciplinary collaboration involving researchers from The Institute of Food and Resource Economics at the Royal Danish Veterinary and Agricultural University (FOI/KVL), National Environmental Research Institute (NERI), and the Danish institute of Food and Veterinary Research (DFVF). The report has been prepared by senior researcher Tove Christensen (FOI), research analyst Morten Mørkbak (FOI), and research analyst Line Block Christoffersen (FOI), senior researcher Berit Hasler (NERI) and research analyst Thomas Lundhede (NERI). Chapter 2 of the report, which includes facts related to food safety and animal welfare of different production systems, has mainly been carried out by project worker Lone Jannok Porsbo (DFVF). We want to thank executive director Mette Wier (akf) for inspiring discussions in preparing the survey, senior researcher Jørgen Dejgård Jensen (FOI) for his help with structuring the report, academic worker Carey Smith (NERI) for linguistic proof reading and secretaries Jytte Loupis and Inger Sommer for editing the final report.

Institute of Food and Resource Economics, May 2006.

Søren E. Frandsen
Director General

Dansk sammendrag

Baggrund og formål

Op gennem 80'erne og 90'erne har vi oplevet en øget interesse for fødevaresikkerhed hos forbrugere, politikere og eksperter. Dette kan ses som en del af en generel stigning i interessen for kvaliteten af fødevarer, men skyldes også en stigning i antallet af fødevarebårne sygdomstilfælde i samme periode. I 2004 blev mellem 18.000 og 74.000 danskere syge som følge af campylobacter infektioner og dermed overhalede campylobacter salmonella, som den mest almindelige årsag til fødevarebårne sygdomstilfælde i Danmark. Samtidig er der ofte omkostninger forbundet med at producere fødevarer med øget sikkerhed. Da prisen ligeledes er en vigtig parameter i forbrugernes indkøbsbeslutninger, er det derfor væsentligt at undersøge i hvilken grad den øgede interesse for fødevaresikkerhed udmønter sig i en øget betalingsvilje.

Nærværende analyse er motiveret af et ønske om at forstå forbrugernes opfattelse og værdisætning af fødevarebårne sundhedsrisici – samt analysere hvordan disse påvirkes af ekspert information. Denne viden er et vigtigt bidrag til formulering af fødevaresikkerhedspolitiske virkemidler, der kan reducere fødevarebårne sundhedsrisici gennem information eller markedsbaserede instrumenter (så som mærkning af fødevarer, prisdifferensiering via afgifter og tilskud etc.). Vi fokuserer på fødevaresikkerhed ved kyllinger, repræsenteret ved bakterien campylobacter, og dyrevelfærd, repræsenteret ved produktionsmetode. Kyllinger menes at være hovedårsagen til humane tilfælde af campylobacter infektioner. Fødevaresikkerhed er en egenskab ved selve produktet (det er ikke synligt, men kan måles), mens dyrevelfærd er knyttet til produktionsprocessen (og er hverken synlig eller målbar i selve produktet). For den gennemsnitlige forbruger er værdien af disse egenskaber en tillidssag, idet egenskaberne ikke kan identificeres – ikke engang efter at produktet er konsumeret. Dette fører os frem til projektets hovedformål:

- At estimere betalingsviljen for øget dyrevelfærd forbundet med dyr, der har adgang til friland i forhold til et konventionelt (indendørs) produktionssystem, samt betalingsviljen for at fjerne risikoen for at blive smittet med campylobacter.
- At analysere hvordan ekspertinformation påvirker forbrugerens præferencer og risikoopfattelse.
- At identificere eventuelle samfundsmæssige gevinster forbundet med at give forbrugeren fuld information, via f.eks. offentlige kampagner eller mærkningsordninger.

- At undersøge om risikoopfattelse og effekt af ekspertinformation varierer på tværs af forbrugergrupper.

Metode og data

Vi benytter valghandlingseksperimenter (på engelsk 'choice experiments') til at estimere forbrugernes betalingsvilje for henholdsvis øget dyrevelfærd og for at undgå campylobacter. Valghandlingseksperimenter er baseret på spørgeskemaundersøgelser, som dækker et repræsentativt udsnit af befolkningen. Vores datasæt består af 2300 respondenter (ACNielsen 2005). Metoden kan benyttes til at udlede forbrugerens præferencer for et givent produkt og dets karakteristika, samt identificere hvilke variable, der har indflydelse på forbrugerens valg (Louviere et al. 2000). Ved yderligere at forsyne forbrugeren med ekspertinformation, som en integreret del af eksperimentet, tillader metoden os at analysere hvordan ekspertinformation påvirker forbrugerens fødevarevalg. Den efterfølgende modellering og estimering er baseret på en multinomial probit model.

Resultater

Vores hovedresultater kan kort opsummeres som følger: Information om campylobacter påvirker ikke betalingsviljen for hverken fødevaresikkerhed eller dyrevelfærd. Information om dyrevelfærd øger betalingsviljen for dyrevelfærd mærkbart, men har kun en indirekte effekt på fødevaresikkerhed via påvirkning af den vægt prisen tillægges. Forbrugerne er villige til at betale for henholdsvis fødevaresikkerhed og dyrevelfærd og hvis begge egenskaber tilbydes samtidig, øges betalingsviljen mærkbart. Disse resultater kvantificeres og uddybes i nedenstående tekst og opsummeres i tabel 0.1. Betalingsviljeestimaterne præsenteres som den ekstra værdi en gennemsnits forbruger er villig til at betale for en kylling indeholdende den givne attribut i forhold til den pris han vil give for en konventionelt produceret kylling, der ikke er kontrolleret for campylobacter. Beskrivelsen foregår i 3 trin.

1) Hvad er betalingsviljen, når der ikke skeles til forskelle i information?
2) Hvordan påvirkes betalingsviljen af information?
3) Hvordan er samspillet mellem betalingsviljen for dyrevelfærd og fødevaresikkerhed?

I første trin skelner vi ikke mellem valg foretaget med eller uden information om de pågældende attributter. Vi finder, at en gennemsnits forbruger oplever højere nytte ved køb af en frilands – og/eller campylobacterfri kylling. I kroner og ører betyder

det, at forbrugeren er villig til at betale en merpris i størrelsesorden kr. 25 for såvel en frilands kylling som for at undgå campylobacter risiko.

I andet trin analyserer vi, om værdien af henholdsvis fødevaresikkerhed og dyrevelfærd ændres, når forbrugeren får information om egenskabernes karakter. Vi ser at opdrætsinformation næsten fordobler betalingsviljen for dyrevelfærd, mens campylobacter information ikke påvirker forbrugerens opfattelse af hverken dyrevelfærd eller fødevaresikkerhed. Mere præcist finder vi, at den ekstra betalingsvilje for en frilands kylling stiger fra kr. 20, når forbrugeren ikke har fået information om opdrætsform til kr. 42, når forbrugeren havde fået information om opdrætsform. Dette skal sammenlignes med en gennemsnitlig betalingsvilje på kr. 25, når man ikke skelner mellem forskelle i information. Forbrugerne er således villige til at betale op til kr. 22 for at få information om opdrætsmetoden. Betalingsviljen for fødevaresikkerhed stiger smule, når forbrugeren får information om opdrætsmetode – det er en indirekte påvirkning som følge af en generel ændring i prisfølsomheden. Opdrætsinformationen reducerer forbrugernes prisfølsomhed, hvilket kan ses som et tegn på at forbrugerne lægger mindre vægt på prisen og mere vægt på dyrevelfærd, når de ved mere om de forskellige opdrætsmetoder.

Den bedste beskrivelse af betalingsviljen fåes ved at inddrage samspillet mellem dyrevelfærd og fødevaresikkerhed (trin 3). Hermed har vi mulighed for at analysere, om værdien af øget dyrevelfærd afhænger af, om produktet også kan tilbyde øget fødevaresikkerhed. Vi finder følgende resultater. Når der ikke gives information om dyrevelfærd, er den gennemsnitlige forbruger villig til at betale en merpris på kr. 13 for en frilands opdrættet kylling, kr. 16 for en campylobacterfri kylling, og kr. 43 for en kylling, der både er campylobacterfri og opdrættet på friland sammenlignet med hvad man vil betale for en standardkylling. Med opdrætsinformation er de tilsvarende merbetalingsviljer estimeret til kr. 34 for en frilands opdrættet kylling, kr. 19 for en campylobacterfri kylling og kr. 70 for en kylling indeholdende begge karakteristika.

Forbrugernes præferencer er således tydeligvis ikke additive for de to kvalitetsattributter. Det ses nemmest ved først at kigge på en situation uden opdrætsinformation. En gennemsnits forbruger er ikke bare villig til at betale kr. 20 mere for en frilands opdrættet kylling – men derimod kun kr. 13 mere hvis kyllingen ikke er mærket campylobacterfri, og kr. 43 mere hvis kyllingen er mærket campylobacterfri. Ligeledes er den ekstra betalingsvilje for campylobacterfrie kyllinger ikke bare kr. 22, men kr. 16 når kyllingen er produceret i et konventionelt indendørs staldsystem og kr. 43, når kyllingen kommer fra en frilands produktion. Den direkte sum af betalingsviljerne for

fødevaresikkerhed og dyrevelfærd er kr. 29 (16+13), men når kyllingen opfylder begge egenskaber samtidig er den samlede mer-værdi af fødevaresikkerhed og dyrevelfærd kr. 43 per kylling. Dette indikerer at der er en ekstra betalingsvilje på kr. 14 per kylling, hvis den indeholder begge attributter.

Samme mønster ses i situationen med opdrætsinformation. Den gennemsnitlige forbruger er ikke bare villig til at betale kr. 42 ekstra for en frilands kylling sammenlignet med en kylling produceret konventionelt - han vil kun betale kr. 34 for en frilands kylling, hvis den ikke er kontrolleret for campylobacter, men kr. 70 hvis kyllingen både er produceret på friland og campylobacterfri.

Tabel 0.1. Betalingsvilje estimaterne fra de forskellinge modeller

	Trin 1 Betalingsvilje for dyrevelfærd og fødevaresikkerhed	Trin 2 Betalingsvilje for dyrevelfærd og fødevaresikkerhed når forskelle I information inddrages	Trin 3 Betalingsvilje når samspil mellem dyrevelfærd og fødevaresikkerhed inddrages
Dyrevelfærd	25	20	13
Dyrevelfærd (med opdrætsinformation)		42	34
Fødevaresikkerhed	23	22	16
Fødevaresikkerhed (med opdrætsinformation)		26	19
Dyrevelfærd og fødevaresikkerhed			43
Dyrevelfærd og fødevaresikkerhed (med opdrætsinformation)			70

Note: Tabellen viser hvor meget den gennemsnitlige forbruger er villig til at betale ekstra for de pågældende egenskaber I forhold til en konventionelt produceret kylling der ikke er kontrolleret for campylobacter.

Ligeledes er værdien af opdrætsinformation på kr. 22 et gennemsnit af en værdi på kr. 21, når kyllingens campylobacter indhold ikke er kendt og kr. 27, når kyllingen er campylobacterfri.

I relation til prioritering mellem fødevaresikkerhed og dyrevelfærd finder vi, at der stort set er samme betalingsvilje for fødevaresikkerhed og dyrevelfærd, når forbrugerne ikke har fået information om opdrætsmetode, mens betalingsviljen for dyrevelfærd næsten fordobles i forhold til fødevaresikkerhed, når forbrugerne har fået information om opdrætsmetode.

Konklusion og perspetivering

Markedsimplikationer

I undersøgelsen fandt vi en gennemsnitlig betalingsvilje på kr. 43 for en campylobacterfri frilands kylling i forhold til en konventionelt opdrættet kylling, der ikke er kontrolleret for campylobacter. Betyder dette resultat at værdien af det danske kyllinge marked kan stige med kr. 43 for hver kylling, der sælges, hvis man fokuserer på frilands campylobacterfrie kyllinger alene? Ikke direkte. For ikke at drage forhastede konklusioner, nævnes nedenfor en række elementer som bør indgå i beslutningerne.

Betalingsviljeestimaterne er baseret på en situation, hvor campylobacterfrie kyllinger er nemt tilgængelige for forbrugeren – og samtidig bliver forbrugeren instrueret om kun at have fokus på fødevaresikkerhed, dyrevelfærd og pris, når de skal træffe deres valg. Dette afspejler ikke helt, hvad der foregår i en faktisk købssituation, hvor disse karakteristika ikke nødvendigvis er til stede på samme synlige måde. Samtidig er der et utal af produkt karakteristika, som forbrugeren yderligere skal tage stilling til, hvilket kan medføre at karakteristika som fødevaresikkerhed og dyrevelfærd bliver tilsidesat eller måske helt glemt.

Den nuværende merpris for en campylobacterfri kylling er kun på et par kroner per kg. Sammenlignes dette med resultaterne fra vores undersøgelse, tyder det på, at der er et stort potentiale i at øge markedet af campylobacterfrie kyllinger. Yderligere forskning i årsager til den store forskel mellem hvad folk siger, og hvad de gør, vil være utrolig værdifuld.

I undersøgelsen spurgte vi respondenterne om deres næste valg af kylling (en marginal vurdering) – vi bad dem ikke om at vurdere samtlige valg af kyllinger ud i al fremtid. Man kunne forvente at respondenten ville reducere deres betalingsvilje, hvis det var blevet klargjort at deres valg skulle dække et mere eller mindre permanent skift i deres køb af kyllingeprodukter - ikke bare den næste kylling. Et permanent skift ville klart have større budgetmæssige konsekvenser og muligvis medføre at forbrugerne ville købe færre kyllinger og/eller substituere over til en anden form for kød,

hvis prisen var for høj. De aggregerede markedseffekter forventes derfor at være mindre end de marginale effekter.

Den ikke-liniære sammenhæng mellem fødevaresikkerhed og dyrevelfærd indikerer et potentiale i produktion af en vare indeholdende begge karakteristika i stedet for at producere to varer med hver deres kvalitetsegenskab. Vores resultater indikerer yderligere, at sådanne nicheproduktioner er stærkt afhængige af informationer til forbrugeren vedrørende produktet.

Sidst kan nævnes, at det ikke er forbrugerens efterspørgsel, der bestemmer hvad der står på hylderne i supermarkedet – det er detailhandlen. Vi har estimeret efterspørgslen fra forbrugerne, men i det moderne marked mødes forbrugerne og producenterne sjældent direkte. Producenterne er ofte repræsenteret ved producent organisationer, som koordinerer produktionen. Forbrugernes efterspørgsel er afhængig af de varer som er tilgængelige for dem i butikkerne. Detailhandlen vil selvfølgelig prøve på at efterkomme forbrugernes efterspørgsel, men samtidig har de også deres egen agenda, nemlig at maksimere egen profit. Derfor skal forbrugernes betalingsviljer gennem et filter (som er detailleddets præferencer) før de når producenterne (organisationer). Derfor kræves mere viden om hvordan forbrugernes erklærede præferencer opfattes af detailleddet, før vi kan evaluere vores resultaters betydning for selve markedet.

Politiske implikationer
Set fra en politisk synsvinkel, er der en stor forskel på fødevaresikkerhed og dyrevelfærd. Fødevaresikkerhed påvirker direkte de offentlige sundhedsudgifter, mens der ingen direkte effekter eller omkostninger er for samfundet ved dyrevelfærd. Derfor er den økonomiske interesse for offentlige myndigheder ikke så direkte, når der ses på dyrevelfærd, som ved fødevaresikkerhed.

Vores resultater indikerer at der er et potentielt marked for sikre fødevarer, hvis forbrugeren har en reel valgmulighed. Som situationen er i dag ved mange forbrugere slet ikke, hvilke afvejninger de faktisk foretager sig i deres daglige indkøb (eksempelvis svarede kun godt halvdelen, at frilands kyllinger har større risiko for at indeholde campylobacter end konventionelle kyllinger). F.eks. er en salmonellafri kylling måske ikke altid mærket salmonellafri fordi en sådan mærkning vil lede opmærksomhed hen mod produkter som ikke er mærket. En mulig kilde til den tilsyneladende forskel mellem hvad folk siger, og hvad folk gør, kan derfor ligge i, at de ikke reelt har mulighed for at gøre det, de siger. Vores undersøgelse peger på, at fødevarerisici kan reduceres ved at forsyne produkterne med mærkater, som gør det muligt for forbru-

gerne at vælge campylobacterfrie kylllinger. Vi fandt dog ingen velfærdsøkonomisk gevinst ved yderligere at informere forbrugerne om campylobacter. Ligeledes fandt vi, at mærkning af produkter med høj dyrevelfærd kunne give en velfærdsøkonomisk gevinst, og at der ved en samtidig informationskampagne om dyrevelfærd kunne opnåes en yderligere velfærdsgevinst[1]. Vi så, at betalingsviljen varierer mellem forbrugertyper. Tilgengæld fandt vi ikke nogen systematisk forskel i betydningen af informationen mellem forbrugertyper, så en evt. målretning af informationsindsatsen bør baseres på andre kilder.

Vores resultater indikerer, at givet de rette omstændigheder er forbrugerne villige til at betale for fødevaresikkerhed og dyrevelfærd. Det er dog ikke den eneste mulighed for at få et marked for disse karakteristika. Offentlige myndigheder kan via skatter på varer forbundet med fødevarerisici og/eller subsidier på sikre fødevarer påvirke de relative priser, og derved ændre både efterspørgsel og udbud af sikre fødevarer.

Generalisering

De blandede resultater af effekten af expert information er ikke overraskende. Dette skal ses i lyset af, at den generelle litteratur om risikoopfattelse antyder, at der er forskel på forbrugernes og eksperternes risikoopfattelse (Sunstein, 2002; Williams & Hammit, 2001). Selvfølgelig er det muligt, at den manglende effekt af at give respondenterne campylobacter information kan tilskrives selve den information, der blev givet (vi testede én type campylobacter information, hvor vi beskrev sygdomsforløb og risiko og gjorde det klart for respondenten at fødevaresikkerhed kunne opnåes ved andre tiltag end campylobacterfrit kød, så som at forbrugeren kunne have en bedre køkkenhygiene). Den manglende effekt kunne dog også relateres til det faktum, at fødevaresikkerhed er en attribut, med karakter af såvel et privat gode som offenligt gode. Den manglende effekt af information om campylobacter kunne indikere at forbrugerne har en stærk opfattelse af, hvad der påvirker deres eget helbred (den private del af egenskaben), og at denne opfattelse ikke let kan ændres. For dyrevelfærd, som er et offentligt gode, fandt vi, at jo mere forbrugerne vidste om forskellene mellem produktionssystemerne, des mere var de villige til at betale for en forbedring af dyrevelfærden. Det kan ligeledes henføres til den specifikke information, der blev givet (de produktionsmæssige forskelle blev nævnt, mens det var lagt over til forbrugeren at relatere dem til forskelle i dyrevelfærden). Det er dog også en mulighed at forfølge ovenstående fortolkning vedrørende offentlig og private egenskaber. Herved kan den store

[1] Forudsat at mærknings- og informationsomkostninger er mindre end den fundne merbetalingsvilje.

effekt af opdrætsinformation relateres til at dyrevelfærd er et rent offentligt gode, hvorom forbrugerens præferencer lettere kan påvirkes.

I nærværende undersøgelse værdisatte vi fødevaresikkerhed i relation til at undgå campylobacter i en hel fersk kylling. Samtidig gav 42% af respondenterne udtryk for, at deres tidligere kendskab til salmonella havde påvirket deres valg. Hayes et al. (1995) fandt lignende resultater, hvor folk ikke skelnede mellem forskellige bakterielle risici. Endvidere refererer et sociologisk studie til, at når folk diskuterer zoonoser, så er det generelt indenfor en salmonellaramme, mens andre zoonoser som eks. campylobacter tilsyneladende ikke er noget folk er bevidste om (Lassen et al., 2002). På en side gør den manglende skelnen mellem forskellige bakterier det lettere at generalisere resultaterne til at omfatte andre fødevarerisici, på den anden side vanskeliggøres hele spørgsmålet om additivitet af forskellige fødevarerisici. Der er en stigende interesse og fokus på forskning vedrørende generalisering og overførsel af værdisætningsresultater fra et studie til andre områder (på engelsk 'benefit transfer') (Arrow et al. 1993; Desvousges et al. 1992) og jo flere byggesten vi kan sørge for, desto bedre vil den overordnede økonomiske vurdering blive. Derfor er case studier nyttige og vigtige. En videre forskning i, hvordan resultater kan generaliseres, vil være meget værdifuld.

English summary

Background and objectives

Citizens, public decision-makers as well as experts have shown an increasing interest in food safety issues. This interest first emerged in the 1980s, but remains a hot issue. This can be seen as part of a general increase in attention towards quality characteristics, but is also caused by the increased number of food-borne zoonotic infections that have been registered over the period. In 2004, in Denmark, there were between 18,000 and 74,000 human cases of campylobacter infection, the most common zoonotic infection.

The motivation for the present study is to understand consumer risk perception and food choice in relation to food-related health risks – and how choices and preferences are influenced by expert information. The focus is on the attributes of food safety and animal welfare, represented by campylobacter contents and methods of breeding chicken, respectively. Chicken meat is believed to be the main source of campylobacter infection. Food safety is a characteristic that appears in the product itself – it is not visible, but can be measured. Animal welfare, on the other hand, is linked to the production process only and is not a characteristic of the product itself. For the typical consumer, these characteristics are credence attributes. The pricing of such attributes is subject to informational problems and the attributes do not have a market price that can be used to reflect their values. Therefore, identifying whether there is a willingness to pay for food safety and investigating the effect of information are important inputs in defining food safety policy and in finding ways to reduce the food hazards through provision of information or market-based instruments (such as labelling of safe products, the distortion of prices through taxes or subsidies). More specifically, the objectives are to:

- Estimate the willingness to pay (WTP) for animal welfare achieved via outdoor production systems, and ensure food safety by avoiding campylobacter risks.
- Focus, in particular, on how information on *expert advice,* based on scientific risk assessment, influences preferences and risk perception.
- Identify the possible welfare gains of providing full information to consumers by means of public campaigns and labelling.
- Investigate how risk perception and the effect of information vary across *consumer types.*

Method and data

A prospective analysis was performed, using choice experiments to measure consumer valuation of animal welfare and campylobacter-free products. Furthermore, by providing information as an integrated part of the experiments, the approach allowed measurement of the way in which information on expert-based risk assessment influences choice behaviour. The choice experiment method can be used to elicit consumer preferences and identify variables influencing consumer choice through surveys (Louviere et al, 2000). A questionnaire was designed consisting of a choice experiment part and a part where the respondent was asked to state attitudes towards foods, in general, and food safety and animal welfare in particular. A sample of 2,300 respondents was used (ACNielsen, 2005). The data are analysed using a multinomial probit model.

Results

In short, it was found that campylobacter information did not affect the willingness to pay for either food safety or animal welfare and that breeding information had great effect on the willingness to pay for animal welfare, but only a slight indirect effect on food safety through changes in the price sensitivity. Furthermore, a significant willingness to pay for food safety and animal welfare was revealed, the values of the two attributes, were found to be interrelated. The monetary values are presented in Table 0.2. Next, we present the results more intuitively and in greater detail. The willingness to pay (WTP) estimates are described in three steps,

1) WTP when differences in information are disregarded
2) The effect of information
3) The interaction between food safety and animal welfare

When no distinction was made as to whether the choices were made with or without information about the attributes (Step 1), an average consumer gains positive utility when buying an outdoor-bred chicken or when buying a campylobacter-free chicken. In monetary terms, the price premium for an average consumer was estimated to be around 25 DKK for an outdoor-bred chicken as well as for avoiding campylobacter.

The information on the respective attributes was then incorporated (Step 2). Breeding information was found to be of importance to the consumer – but not campylobacter information. Inclusion of information regarding breeding methods almost doubles the utility of the animal welfare attribute, in relation to inclusion of information on campylobacter or not receiving any information at all. In monetary terms, it means that

the willingness to pay for animal welfare is not simply 25 DKK – it is 42 DKK when breeding information is provided and 20 DKK when information is not provided. In other words, when consumers buy outdoor-bred chicken, they are willing to pay up to 22 DKK for breeding information. Food safety is not directly affected by breeding information but an indirect effect is apparent through changes in price sensitivity. Providing breeding information reduces consumers' price sensitivity. This can be interpreted as consumers placing less importance on the price and more emphasis on animal welfare when they have more information with regard to the differences in the respective breeding systems. The lower price sensitivity causes a slight increase in the willingness to pay for food safety when breeding information is provided. The relative valuations of food safety and animal welfare are thus affected by breeding information. Without breeding information, the willingness to pay for food safety and animal welfare are very similar. However, after breeding information is provided, the value of animal welfare is almost twice as high as food safety.

The best description of consumer behaviour is obtained when the interaction effect of the two attributes is included and when a distinction is made between attributes with and without breeding information (Step 3). In short, it is found that the willingness to pay estimates when no breeding information is provided, are 13 DKK for outdoor-bred, 16 DKK for campylobacter-free chickens and 43 DKK for both attributes. With breeding information, the willingness to pay estimates are 34 DKK for outdoor-bred, 19 DKK for campylobacter-free chickens and 70 DKK for both attributes. This demonstrates a very clear indication of consumers preferences being non-additive in quality attributes – this result should be investigated further for other quality attributes as well.

An average consumer is not just willing to pay 20 DKK for an outdoor-bred chicken (without breeding information). The willingness to pay is 13 DKK when the chicken has no campylobacter label and 43 DKK when the chicken is campylobacter-free. Similarly, the willingness to pay for avoiding campylobacter (without breeding information) of 22 DKK is actually an average over 16 DKK when the chicken is raised indoors and 43 DKK when the chicken is raised outdoors. The direct sum of the willingness to pay for food safety and animal welfare is 29 DKK, but when food safety and animal welfare are offered jointly, the value amounts to 43 DKK. This means that there is an extra willingness to pay of 14 DKK per chicken above the willingness to pay for the individual attributes. This result is not driven by information because we consider the case without breeding information – the result is simply driven by the non-linearity of consumers' preferences for food safety and animal welfare.

Similar non-linearity applies when breeding information is provided. An average consumer is not simply willing to pay 42 DKK for an outdoor-bred chicken compared with an indoor-bred chicken – the average willingness to pay for outdoor chicken is 34 DKK when the chicken has no campylobacter label and 70 DKK when the chicken is campylobacter-free. Moreover, the willingness to pay for avoiding campylobacter is not simply 26 DKK – it is 19 DKK when the chicken is raised indoors and 70 DKK when the chicken is raised outdoors.

The monetary values of information change when the joined combinations of animal welfare and food safety are included. The value of breeding information when buying outdoor-bred chicken is not simply 22 DKK[2]– the value of information is 21 DKK when the chicken's campylobacter contents are not known and it is 27 DKK when the chicken is campylobacter-free.

Table 0.2. Willingness to pay estimates for the different models

	Step 1 WTP for food safety and animal welfare	Step 2 WTP including differences in breeding information	Step 3 WTP including differences in breeding information and interaction between food safety and animal welfare
Animal welfare	25	20	13
Animal welfare (with breeding information)		42	34
Food safety	23	22	16
Food safety (with breeding information)		26	19
Animal welfare and food safety			43
Animal welfare and food safety (with breeding information)			70

Note: The table shows additional willingness to pay per whole chilled chicken with various attributes compared with a standard chicken (indoor-bred and not labelled campylobacter-free).

[2] The value of information when buying outdoor bred chicken of 22 DKK is calculated as 22=42–20 DKK (see Table 0.2).

Individual characteristics were found to affect willingness to pay. For example, it was found that knowledge of campylobacter (or salmonella) did not result in differences in willingness to pay for food safety but consumers with personal experience with campylobacter had larger willingness to pay for avoiding campylobacter. Similarly, people who consider their health to be poor showed increased willingness to pay for food safety. Consumers with higher education and preferences for organic products did show significantly higher willingness to pay for animal welfare than other consumers.

Conclusions and perspectives

Market implications

An average willingness to pay of 43 DKK per chicken for avoiding campylobacter in an outdoor-bred chicken was found. Does that mean that the value of the Danish chicken market could be increased by 43 DKK for each chicken sold by focusing exclusively on outdoor-bred campylobacter-free chickens? Before jumping to any conclusions in this regard, a range of elements should be considered.

The results are created in a situation where a campylobacter-free chicken is readily available and accessible and the consumer is instructed to focus on food safety, animal welfare, and price. This contrasts with a real market situation where these conditions are not necessarily present and where there is a myriad of trade-offs to be made. Furthermore, the trade-offs are at times not even known, due to lack of information. For example, a salmonella-free chicken is not always labelled because it might draw too much attention towards the food risks associated with other products that are not labelled. Hence, the willingness to pay for food safety and animal welfare has been derived under certain specific conditions.

Today, the price premium for a campylobacter-free chicken is only a few DKK per kg. A comparison with the willingness to pay results from the analysis indicates a great potential for increasing the market for campylobacter-free chickens. Further research into the underlying reasons for such a discrepancy would be very valuable.

The consumers were asked to assess their next choice of chicken (a marginal valuation task) – all future choices of chicken were not assessed. Hence, when consumers consider the budgetary effects of paying 43 DKK more for not just the next chicken but all chicken they buy, they may wish to reduce their consumption of outdoor-bred campylobacter-free chickens and buy other chicken products – or substitute chicken with other types of meat. Therefore, the aggregate market implications can be expected to be lower than the marginal effects.

Another market implication of our results is that the non-linearity of attribute values indicates that their might be niche production opportunities in producing goods with specific *bundles* of characteristics – such as campylobacter-free chicken with improved living conditions. Additionally, our results indicate that survival of these niche productions might depend on information provision.

Finally, consumers do not determine demand – the supermarkets do. We have estimated the demand from consumers. However, in the modern markets, the consumers and producers seldom meet. Producers are represented by producer organisations who coordinate production. Consumers' demand depends on what they can buy in the shops. Of course, the retailers will try to satisfy consumer demand – but they also have their own agenda of maximising profits. Therefore, consumers' willingness to pay have to go through a filter (which is the preferences of the retailers) before they reach the producers (organisations). Hence, before we can assess the market implications of our results, more needs to be known about how consumers' stated behaviour is perceived by retailers/main supermarkets.

Policy implications

From a policy point of view, a major difference between food safety and animal welfare is that the externality element in food safety affects public health costs whereas there are no direct expenditures related to animal welfare. Therefore, economic interest on the part of the public authorities is not as outspoken with respect to animal welfare as with food safety.

The present results indicate that food risks can be reduced by providing labels that allow consumers actually to choose campylobacter-free and/or animal welfare chicken. No welfare gains in providing information about campylobacter were found but the results indicate a substantial additional welfare gain in providing animal welfare information that supports the labelling[3]. Willingness to pay varied across consumer types, but no systematic differences were found across consumer types in relation to how information affects the willingness to pay. Hence, advice for targeting information campaigns cannot be provided on the basis of the analysis.

The results indicate that, given the right circumstances, consumers are willing to pay for food safety and animal welfare. But this is not the only way to secure provision of these attributes. Public authorities can affect the relative prices by issuing taxes on

[3] Provided that labelling and information costs are less than the differences in willingness to pay.

goods associated with food risks and/or subsidies on safe food products. Thereby, the public costs of food risks are internalized and the relative prices make it easier (relatively cheaper) for consumers to choose a low risk product.

Generalisation

The mixed results on the effects of expert-based information are not surprising in the light of the general literature on risk perception that suggests a disparity between consumer risk perception and scientific risk assessment (Sunstein, 2002; Williams & Hammit, 2001). Of course, the lack of effect of campylobacter information can be attributed to the specific piece of information that is provided (only one type of campylobacter information was tested where the symptoms and risks of campylobacteriosis were described and it was emphasised that food safety can be achieved by means other than use of campylobacter-free meat – by good kitchen hygiene). It could, however, also be related to the fact that food safety is an attribute with private as well as public good characteristics. The lack of effect from providing campylobacter information could indicate that consumers have strong beliefs about factors that affect their own health and that these beliefs are not easily changed. Animal welfare, on the other hand, is a pure public good. The more consumers knew about the differences between production systems, the more they were willing to pay for improvements. Again, this could be due to the specific piece of information that is provided (only differences in production systems are described leaving it to the consumers to link these to differences in animal welfare). However, it could also indicate that consumers do not have strong prior beliefs about the public good and that their preferences towards public characteristics are more easily affected than their preferences towards private characteristics.

Food safety related to avoiding campylobacter in one whole chilled chicken was valued. At the same time, 42 % of the respondents stated that previous knowledge about salmonella affected their choices and similar results are found in Hayes et al. (1995). More knowledge about how consumers perceive different food risks is valuable.

There has been an increasing focus on research with regard to how to transfer benefits (Arrow et al. 1993; Desvousges et al. 1992) and the more building bricks that can be provided, the better overall economic assessment will be. Case studies, therefore, provide an important input. Further research in how to generalise results would be highly valuable.

1. Introduction

1.1. Background

The interest in food related issues

Food consumption has always been a matter of keen interest and concern. Historically, concern has focused on securing sufficient intake of food in order to avoid malnutrition and starvation. Food risk was associated with the risk of not having enough food, as is still the case in many parts of the world. In industrialised countries, however, the focus on the consumption of food has changed dramatically and is now rather a question of how to limit the intake of food in order to avoid obesity[4], while at the same time securing a safe and nutritious, and of course well-tasting, diet. Food safety, today, is a matter of foods being free from a range of attributes and characteristics, such as microbiological bacteria (e.g. salmonella, campylobacter), natural toxins, chemicals and medical residuals. For some consumers, absence of genetically modified organisms, growth hormones and radiation are also important attributes for their associations of "food safety" (see Andersen & Christensen, 2004). Some food quality attributes are related to the product itself (such as taste, texture, nutrition, convenience, food safety, packaging, etc.) and some attributes are related to the production process (such as animal welfare, environmental impact, production organisations, being free from genetically modified organisms[5]) (Jensen, 2002).

Danish consumers focus on the price of food products, but at the same time the interest in food safety appears to be on the increase, and one interesting question is if this interest forms part of a general increase in attention to quality characteristics? An interesting research question is to what extent the increase in the interest in food safety, animal welfare, environmentally friendly production methods, etc. is reflected in higher willingness to pay for food products with these attributes?

More specifically, the issue is one of assessing the private and the public preferences, and *demand* for these quality attributes. It is possible to reduce several of the risks (and thereby create a *supply* of these attributes), but an important obstacle is that products ensuring attributes such as regard for the environment or which are residue-free, GMO-free, salmonella and campylobacter-free, etc. are more costly compared

[4] And the obesity-related increased risk of illness.

[5] Organic product qualities are related to the production process (organic rules concerning animal welfare, exclusion of GMOs, environmentally regard, etc.) as well as to the final product (absence of chemicals, medical residuals).

with conventional products. Therefore, an essential concern is the extent to which consumers are willing to pay a price premium for goods which offer these attributes.

Choice is complex

Choosing the food products that provide the highest individual welfare is not necessarily an easy task. When consumers choose the food products to put in their shopping basket, they implicitly or explicitly assess some or all attributes of all products – the assessment being dependent on the characteristics of the goods. One important attribute is the price of the product, but also risk perception, cultural and socio-demographic factors, as well as practical matters such as availability, visibility in the shop, and time available for shopping, are all important determinants of food choice. On one hand, the consumer lacks information about the attributes that are not visible. On the other hand, the cognitive burden of digesting the available information concerning qualities, risks, prices, etc., while encompassing the range of available relevant products, can be enormous. Last but not least, the consumer must perform trade-offs between different desirable attributes – partly due to the budget constraint and partly due to the trade-off involved in the choice between different products. One example is the choice between different meat products – the consumer can choose between beef, veal, pork, lamb and chicken, and further between meat of different qualities and with different attributes – as discussed above. If a consumer chooses to buy chicken, the choice between products involves a trade-off between food safety, price, and animal welfare. The consumer can choose between organic and conventionally bred chickens, and between products that are labelled campylobacter- and salmonella-free or not labelled at all, etc. Organic chickens have outdoor access and more space than chickens bred in an indoor production system, so the animal welfare of this production system is likely to be better. At the same time, organic chickens have a higher prevalence of *Campylobacter* compared with chickens bred indoors. The choice between conventionally bred chicken and organic chicken, therefore, involves a trade-off between food safety, animal welfare and price. Today, researchers as well as the relevant authorities have limited knowledge on how consumers understand and act upon complex situations with multidimensional risks, incl. making trade-offs between various risk types. These issues provide interesting research questions, where the answers can be used to guide the authorities on how best to inform consumers.

This study

The focus of the present study is how interest for food safety and animal welfare is reflected in consumers' willingness to pay for these attributes when they purchase fresh chicken meat. The willingness to pay (WTP) estimates are elicited by the stated

preference method, choice experiments (CE), as this method allows for presentation of food safety and animal welfare choices in a trade-off, including the trade-off with price, i.e. the choices resemble the choices consumers make in their everyday life.

Food safety concerns are exemplified by whether or not the chicken is campylobacter-free, while animal welfare is represented by breeding method. Food safety is a characteristic that appears in the product itself – it is not visible but can be measured. Animal welfare, on the other hand, is linked to the production process only and is not a characteristic of the product itself. None of these attributes are traded as individual goods – you can not buy one bag of food safety or a pint of animal welfare – but they appear in a variety of animal products.

Food safety and microbiological concern

Through the 1980s and 1990s, the number of food-borne zoonotic infections increased and led to an increased awareness of microbiological food safety. Figure 1 shows the development in the number of human infections for the most important zoonoses in Denmark (*Salmonella, Campylobacter* and *Yersenia*). Historically, Salmonella has been the most common bacterial zoonosis in Denmark, and therefore the most well known. Since 1999, however, this dubious honour goes to Campylobacter instead. In 2004, the number of human incidences registered was 3,724, which corresponds to an incidence of 69 registered cases per 100,000 inhabitants, twice as high as that for salmonellosis[6]. The main source of Campylobacter is believed to be chicken. The number of cases of campylobacter infection indicates considerable societal costs. Identifying whether or not there is a willingness to pay for campylobacter-free products and investigating the effect of information are necessary inputs to finding ways in which to reduce the number of campylobacter infections.

Animal welfare

Animal welfare is one of many food quality attributes. In order to assess policy issues, such as potential market failures related to externalities in production and informational asymmetries, it is useful to distinguish between animal health and animal welfare. Animal health will typically affect the production value of the animal, as healthy animals gain more weight, produce more milk, etc. Hence, taking animal health into account in production decisions is in the farmers own economic interest. This compatibility between public and private preferences for animal health implies that the consumer can trust the farmer to produce healthy animals, hence informational

[6] Anonymous (2005) p. 10 & 18 Epi-News, no. 9 (2005).

asymmetries do not constitute problems. With respect to animal welfare, on the other hand, a clear discrepancy exists between consumers and farmers preferences and perceptions of animal welfare. The differences in preferences arise primarily because farmers do not necessarily have economic incentives to secure high animal welfare. For example, it is a good investment to increase animal welfare to some extent but perhaps not to the extent consumers perceive as "good" animal welfare. Therefore, animal welfare will only be "produced" by the farmer if he is induced to do so – either by regulation or by a premium which the consumer is willing to pay for the attribute. Describing animal welfare is a rather complicated matter because it includes objective measures of production-related differences, as well as more qualitative perceptions of how humans evaluate how different production systems influence animal welfare. Furthermore, humans can have some ideas on how the preference structure of the animals might be. The complexity in assessing human evaluations (including our interpretation of animal evaluations) of animal welfare is captured in the paradox that, in our part of the world, the phrase "humane treatment" is most often used in relation to animals. In this study, the objective characterisations will be concentrated upon.

Economic valuation

The most common way of exchanging goods and services in modern society is through the market. Market prices reveal consumers' demand. Whenever a good has a market price, this can be used directly to determine its value – provided that the market satisfies certain efficiency requirements. The efficiency requirements include, among other things that no individual firms exercise market power, there is a sufficient number of market participants, there is full information about the products and there are no regulatory distortions. In such a setting, the market price equals the marginal value of the good (cf. Russell & Wilkinson, 1979). Goods that are traded readily in the markets include standard versions of products such as milk, butter, and meat products, where only price determines the quantity demanded.

Other goods or attributes are not, or are only indirectly, traded in a market (recreational sites, pollution, animal welfare, food safety, service). Goods that are not, or only indirectly, traded in markets are termed non-market goods. A good being indirectly traded means that it is not traded as an individual good but it appears as one of many goods in a compound good that is sold in the market. In example, free range pigs are often marketed under the slogan that they provide better living conditions for the animals and taste better. Hence, the value of animal welfare of this good can only be indirectly extracted from the market price by adjusting for taste-effects. Animal

welfare is also traded indirectly as one of many characteristics of organically produced, but organic broilers are also characterised by a variety of other attributes[7].

If a market is too small, then non-economic factors such as availability, shelf-placing and, simply, knowledge of the existence of the food product can dominate to such an extent that it is not possible to provide a reliable estimate for demand. When the markets are too inefficient[8] to provide reliable values by means of market data analyses, stated preference methods provide alternative ways of determining the preferences, by using the hypothetical willingness to pay for the attributes/non-market goods. Examples are salmonella- and/or campylobacter-free broilers. These chickens are marketed, but the Danish markets for these products are rather small. Stated preference methods have been used in environmental economics in recent decades and are also increasingly accepted in the political arena, in for example USA (cf. Hahn, 2000). Also within food economics, there are several recent examples of the application of stated preference techniques, although application in food safety policy is still to come. These techniques are in rapid development and provide ample opportunities for research. Stated preference methods comprise the well known contingent valuation method (CVM) and the more recently developed family of choice modelling techniques, which include the method choice experiments (CE).

Risk perception and information

An important reason why food safety attributes, such as absence of bacteria and pesticides or good conditions for the animal concerned, are not traded is that they are all *credence attributes,* meaning that the value of these attributes cannot be discerned even after consumption. The pricing of such attributes is subject to informational problems in terms of general uncertainty (none of the parties know the exact values of the attributes) as well as asymmetric information (one party – typically the producer, has superior information about the true value of the attributes and has the economic incentive to use this information for private profit).

The problem concerning lack of full information – apart from the moral aspect that somebody might be cheated – is explained as follows. From an economic point of

[7] Therefore, the market price for organic broilers can not be used as indicator for the market price of animal welfare. Instead, the market price of organic chicken can be used as an upper limit of the value of animal welfare

[8] The efficiency requirements include that no individual firms exercise market power, there are sufficiently many market participants, there is full information about the products, no regulatory distortions etc In such a setting, the market price equals the marginal value of good, Russell.& Wilkinson (1979).

view, there is a potential economic welfare benefit in having an informationally efficient market. In other words, if consumers are willing to pay more for specific attributes, there may be a *societal value* associated with providing reliable and independent information – that is, giving consumers a choice among different levels of risk at different prices may be economically efficient (cf. Beales et al., 1981). Thus, providing extra information, ensuring freedom of choice, represents a potential welfare gain.

In relation to food safety there is an additional argument for public intervention – there are *externality* effects of consuming food with risk attached that cause extra costs to society (in terms of hospital expenses, lost productivity in labour markets, etc). To provide effective information, the public sector needs knowledge of consumers' perception of risk and how this affects actual consumption. Understanding risk perception is important for eliciting willingness to pay – for using information as a policy tool.

In order to analyse the demand response to expert-based information, different types of information (labelling, advertising, information from government, researchers, the industry, welfare/environmental groups, education, relative prices) have been characterised. In particular, focus is given to the distinction between labelling and information. Mazzocchi and Traill (2005) suggest the following categorisation of policy measures to rebalance diets. The policy measures are categorised according to how they intervene with market forces.

- Policies which actually change consumer preferences (*information* campaigns, educational programmes in schools)
- Policies aimed at a better informed choice without directly affecting the preferences (*labelling* rules, nutritional information on menus)
- Market policies affecting actual choice without intervening on the preferences (taxes and subsidies)
- Supply side policies affecting availability (limiting access to unhealthy food through food standards, fortification and supplementation, regulate catering in schools)

In our study, the focus is very narrowly on how demand for food safety and animal welfare, respectively, is influenced by expert-based information. According to the above categorisations, our descriptions of attributes (such as "outdoor-bred", "indoor-bred", "campylobacter-free") are clearly *labels* aimed at helping consumers to distin-

guish between the various chicken products, whereas the *information* provided in the choice experiment aims to change the consumers' preferences.

Former valuation studies on animal welfare and food safety

In the vast amount of literature on economic valuation, some studies concerning animal welfare and food safety have been identified, as well as a few where the value of both attributes is estimated.

With respect to animal welfare, Carlsson et al. (2003) found a significant willingness to pay for eggs from free-range versus cage- (battery) production (using a CE analysis). Carlsson et al. (2004b) (also a CE analysis) analysed the willingness to pay for animal welfare related to the use of mobile abattoirs relative to the transportation of farm animals to slaughter houses. They found that willingness to pay a premium for mobile abattoirs depended on whether it was being analysed for beef, pigs, or chicken products. Burgess et al. (2004) found a willingness to pay for improved welfare for chickens, laying hens, dairy cows and pigs. Their results are not significantly dependent on whether double-bounded CVM or paired comparisons were used as elicitation methods. Bennett (1996) found a significant willingness to pay for increased animal welfare in egg production (using CVM). Furthermore, the main concerns with respect to animal welfare in livestock production are (listed in decreasing order): housing and confined living conditions, feed and medicine, livestock transport and livestock markets, and then the slaughtering process. Bennet & Blamey (2003) found that the willingness to support the phasing out the use of battery cages for egg production in the European Union exceeds the costs of phasing out the use of battery cages, over a 12-year period (using CVM).

The willingness to pay for microbiological food safety is analysed in Goldberg & Roosen (2005). They found that consumers are willing to pay for reducing the risks of salmonella and campylobacter (using CE) with the willingness to pay for reducing salmonella risks being a little higher than for reducing campylobacter risks.

Hayes e*t al.* (1995) used experimental auctions for sandwiches to evaluate the willingness to pay for safer food in relation to five different pathogens salmonella, campylobacter, staphylococcus aureus, trichinella spiralis and clostridium perfringens. The respondents were given a test sandwich with unspecified risk of getting ill (a "normal" sandwich) and then offered to buy stringently screened sandwiches with a risk of 1 in 100 million chance of suffering from the pathogen in question from eating the sandwich. Hayes et al. (1995) conclude that in their sample, the consumers under-

estimate rather than overestimate the risk of food-borne illness. Afterwards, the respondents were given information about the risk of the sandwiches in terms of the probability and severity and asked to bid again – this increased the willingness to pay estimates slightly.

Choice experiments (CE) used in former studies in other areas

CE has frequently been used in the evaluation of choices involving consumer goods, transportation, tourism, environmental questions and health-related questions and issues (Hensher et al., 1999; Alpizar et al., 2003). Hobbs (2005) estimate willingness to pay for food safety, traceability and information about the farm from where the product originated from, and found that Canadians are willing to pay a premium of 15-20 % for food safety. Consumers' evaluation of food safety in relation to GMOs is investigated in a number of studies, see Hu et al. (2004), Burton et al. (2004), Carlsson et al. (2004a), James & Burton. (2003) and Kontoleon & Yabe (2003). CE studies on other topics include Alfnes & Rickertsen (2004) on consumer attitudes toward beef tenderness labelling, Boxall et al. (2003) on valuing aboriginal artefacts, Hensher & Reyes (2000) on "trip chaining" as a barrier to the propensity to use public transport, the economic valuation of out-of-hours care and screening methods is examined in Ryan & Miguel (2003), Scott (2002) and McIntosh (2002). Danish studies using CE include Hasler et al. (2005) where groundwater protection versus water purification was investigated, Bech et al. *(2005)* on eliciting women's preferences for a training programme in breast self-examination, Bech et al. (2004) on the examination of students' job expectations for future job possibilities, Gyrd-Hansen & Søgaard (2001) analysing public preferences for cancer screening programmes and Boiesen et al. (2005) on valuation of the Danish heaths. See, furthermore, Bjørner et al. (2004) for a contingent ranking study on biodiversity and health related to changes in the use of pesticides by the agricultural sector, Olsen & Lundhede (2005) on valuing forest attributes, Lundhede et al. (2005) on valuing the restoration of a nature area, Olsen et al. (2005) on valuing alternative paths for a motorway in the western part of Denmark, Ladenburg et al. (2005) on valuing the externalities of off-shore wind farms and Fardan et al. (2005) on valuing the effect of restoring Lake Fure in northern Zealand.

Other valuation studies of the effects of information

There exists a large field of qualitative, sociological studies of risk perception, information and consumer behaviour. Some of these studies point out important results regarding information provision and risk perception, indicating that public authorities play a key role in information provision regarding credence goods, as public informa-

tion is generally trusted (Nayga et al., 2002; Banerjee and Solomon, 2003, Hobbs, 2005). For issues subject to public concern, the government may have an incentive to provide information to consumers by e.g. financing information campaigns, consumer education, promoting and certifying labels, etc. Information such as *expert advice based on scientific risk assessment* is central in this regard. Sunstein (2002) and Williams & Hammitt (2001) suggest a disparity between consumer risk perception and scientific risk assessment and point out a need to improve the understanding of how consumers create their risk perceptions, the extent to which it is influenced by expert-based information provision and how risk perception affects actual demand. Uncertainty with respect of food quality and safety hinders consumers' attempts to match food choices with preferences. Furthermore, food quality and safety issues have received intensive mass media coverage in recent years. This has led consumers and agri-food chain stakeholders to change their beliefs, attitudes and behaviour. There has also been a growing interest, not only in the role and mechanisms of information, but also in the evaluation of the various techniques and vehicles for spreading information. Much effort has been devoted to evaluating the effects of advertising and media coverage of food quality and safety issues; investigating the role of trust and credibility of information sources; and analysing consumer interest in, and use of, available information cues. Verbeke (2005) found that information provision can be successful only if it meets the informational needs of the target audience. The provision of ever more and too detailed information entails the risk of information overload, resulting in consumer indifference or loss of confidence. Instead, segmentation and targeted information provision are proposed as potential solutions to market failure from information symmetries.

Much of today's information about food quality and safety can be classified as risk information that aims at reducing consumers' uncertainty when making purchasing decisions. Current failures of risk information to achieve its goals may stem from gaps in relation to understanding the relationship between individual perceptions, information processing and behaviour (Langford *et al* 1999). Research has shown that lay persons tend to assess relative food risks differently from the expert opinion on the same risks (Lazo et al., 2000; and Hansen et al., 2003). Providing (Marette et al. 1999) or withholding (Mazzocchi et al 2004b) food quality or safety information to consumers may result in considerable welfare effects.

An increasing number of market-based studies and valuation studies have been performed on how advertising and public information affect consumer behaviour and consumers' preferences, cf. Smed & Denver (2005), Bonnet & Simioni (2001), and

Grunert (2005). Only two quantitative studies were found using stated preference methods to address the issue of how information affects consumer behaviour. Both use price auctions as valuation method. Hayes et al. (2002) analyse how positive and negative information, respectively, affect the demand for irradiation of food – they found that the effect of negative information dominates over positive information. Rozan et al. (2004) analyse how information about food safety affects consumers' willingness to pay for certified food products (checked for heavy metal content) versus non-certified products (unknown content of heavy metal). They found that new information, damaging for non-certified products, induces a decrease in the purchase price for non-certified products but not a significant increase in the purchase price for certified products.

1.2. The objectives of the study

The motivation for the present study is to understand consumer risk perception and food choice preferences in relation to food-related health risks – and how these preferences are influenced by expert information. Thereby, it is hoped that the foundation for using information provision as a policy tool can be improved. More specifically, the objectives are to:

- Estimate the willingness to pay for animal welfare achieved by means of outdoor production systems, and ensure food safety by avoiding campylobacter risks.
- Focus particularly on how information on *expert advice* based on scientific risk assessment influences preferences and risk perception.
- Identify the possible welfare gain of providing full information to consumers by means of public campaigns and labelling.
- Identify whether risk perception and the effect of information varies across *consumer types.*

Focus is on eliciting values and trade-offs between two specific attributes: food safety (represented by campylobacter contents in fresh chicken) and animal welfare (represented by breeding methods in chicken production). If information affects consumers' willingness to pay for these credence characteristics, a societal value of information has been found.

1.3. Method

A prospective analysis is undertaken, using choice experiments to measure consumer valuation of various product attributes, such as animal welfare and campylobacter-free products. By, furthermore, providing information as an integrated part of the experiments, the approach allows measurement of how information containing expert-based risk assessment influences choice behaviour.

The choice experiment method can be used to elicit consumer preferences and identify variables influencing consumer choice behaviour. The values of the relevant attributes are estimated by designing a choice task asking the respondents to choose between a set of alternatives, where each alternative is characterised by a different price and different levels of the attributes (Louviere et al., 2000). Choice experiments have become increasingly popular as a valuable tool for elicitation and analysis of preferences for mainly two reasons (cf. Foster and Mourato, 2002). The first reason is their ability to handle multidimensional risks and situations where trade-offs between these risks are prevalent. Secondly, respondents are asked to make choices between alternatives, instead of being asked to carry out the much more complex task of assigning a value to various attributes or risks, as is the case in traditional economic valuation studies.

1.4. Organisation of the report

In Chapter 2, the scientific facts are described concerning campylobacter risks and animal welfare related to different breeding systems in chicken production. This chapter provides the basis for the expert information used in the questionnaire. Chapter 2 also contains short descriptions of the costs of human infections of campylobacteriosis and of the markets for different chicken products. Chapter 3 provides the theoretical foundations for our analysis. A short description of the range of available valuation methods is presented, whereas the method selected in this study, the choice experiment method, is described in greater detail. Data are described in Chapter 4. Firstly, the specific research problem is formulated and the design of the questionnaire is discussed, such that the information retrieved can be used to analyse and answer our research objectives. Secondly, analysis is made of how representative the response sample is of the population, and how the 2,000 respondents are distributed according to personal attitudes towards food safety, animal welfare and food choice, in general. Hence, Chapter 4 provides valuable background information on the sample population. The econometric analyses *and results* are discussed in Chapter 5. Sections

5.2 to 5.4 describe the estimation process in terms of statistical significance of attributes and their marginal utilities. Those results that are formulated as willingness to pay estimates are presented in two parts. Estimates of the willingness to pay and effect of information for an average consumer are presented in Section 5.5. Estimates of how willingness to pay and effect of information vary across socio-demographic variables and personal attitudinal variables are presented in Section 5.6. Chapter 6 contains a discussion of the results.

The appendices document the analyses. Appendix B contains an overview of the literature with respect to economic valuation of the willingness to pay for food safety and animal welfare, and over the literature concerning how information affects willingness to pay. The literature surveyed is also summarised in Tables B1-B4. Appendix C contains illustrative tables of the descriptive statistics presented in Chapter 4. Appendices D-G are linked to the econometric estimations carried out in Chapter 5.

2. Food safety and animal welfare

In the present section, a short description of food safety issues related to campylobacteriosis is provided. Furthermore, two types of poultry production (organic and conventional indoor production systems) are described with special emphasis on issues that relate to animal welfare. Finally, a short description is made of the market conditions for chicken products in Denmark, with special emphasis on the two issues mentioned – food safety and animal welfare.

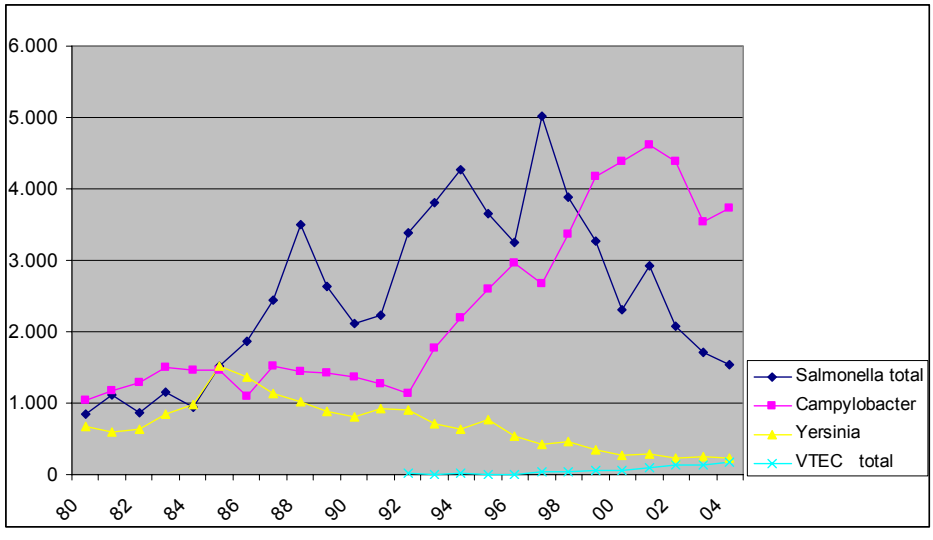
2.1. Campylobacter

Development in *Campylobacter*[9]

Through the 1980s and 1990s, the number of food-borne zoonotic infections increased and sharpened awareness of microbiological food safety. Figure 2.1 shows the development in the number of human infections caused by the most important zoonotic agents in Denmark (*Salmonella, Campylobacter* and *Yersinia*).

[9] *Campylobacter*, *Salmonella*, etc. are written in italics since this chagper is based on experts from natural science, where this notation is standard.

Figure 2.1. The number of human infections caused by the most common zoonotic agents, in Denmark ,1980-2004



Source: www.dfvf.dk
Note: Registered number of cases.

Historically, *Salmonella* has been the most common bacterial zoonosis in Denmark (and therefore most well known) but since 1999, this dubious honour is attributed to *Campylobacter*. In 2004, the number of human cases registered through the laboratory notification system was 3,724 of campylobacteriosis, which corresponds to an incidence of 69 registered cases per 100,000 inhabitants. This is twice as high as for salmonellosis[10] [11].

The actual number of campylobacteriosis and other zoonoses is generally thought to be considerably higher – several sources estimate that the actual numbers are between 5 and 20 times higher.[12]. This would imply that, in 2004, there were actually between 18,000 and 74,000 cases of campylobacteriosis in Denmark.

[10] Anonymous (2005) p. 10, 18 and Epi-News, no. 9 (2005)
[11] In 2004, 1,538 cases (28 registered cases per 100,000) of salmonellosis were reported
[12] According to Korsgaard et al (2005), European and American studies have estimated that the actual numbers of infections are 5 – 20 times higher than the recorded cases. The Danish ministry of Food, Agriculture and Fisheries estimate the actual number of cases to be 10-15 times higher than the registered number (www.fvm.dk); in Taenk og test (2001) the estimate is up to 25 times higher; and in EFSA (2005) p. 18, a factor 7 to 100 times higher is reported.

Symptoms of campylobacteriosis

Campylobacteriosis is a bacterial disease which can be seen in all age groups in industrialised countries. The symptoms are described in Box 2.1. Campylobacteriosis is a zoonotic infection, i.e. an infection that may be transmitted directly from animals to humans. Zoonotic infections such as campylacteriosis may arise following ingestion of contaminated foodstuffs or water, or from contact with infected animals.

Box 2.1. Symptoms of campylobacteriosis

Common symptoms: *Campylobacter* is usually associated with mild to severe infection of the gastrointestinal system, resulting in watery and frequently bloody diarrhoea, fever, abdominal pain and cramps, nausea, and vomiting.
Many cases are asymptomatic and usually self-limiting. The infection is clinically indistinguishable from infections caused by other zoonotic agents such as *Salmonella* and *Shigella*. However, when groups of patients are compared, those with campylobacter enteritis experience more severe abdominal pain, which can be so sever that they are transferred to hospital with suspected appendicitis (Skirrow, 1998). A definite diagnosis can only be made by detecting *Campylobacter* in clinical specimens (Annex, 2004).

Duration: From 1 to 7 days and in 20% of the cases the illness lasts for more than a week (Annex, 2004).

Incubation period: From 1 – 7 days.

Occasional symptoms: Some patients suffer rigors, high fever, and even delirium; children may have febrile seizures (Skirrow, 1998). More invasive disease such as systemic infection occurs in less than 1% of the patients with *C. jejuni* infections. Campylobacteriosis has been associated with chronic sequela that include reactive arthritis, inflammation of the liver and kidney. A rare complication of *Campylobacter* infection is Guillain-Barré syndrome, an acute flaccid temporal paralysis of the peripheral nervous system that occurs approximately 2 weeks after the initial illness develops. The immune system is "triggered" to attack the body's own nerves, and can lead to paralysis that lasts several weeks and usually requires intensive care. It is estimated that approximately one in every 1,000 reported campylobacteriosis cases leads to Guillain-Barré syndrome (Annex, 2004). A fatal outcome is rare and is usually confined to elderly or very young or the immuno-compromised, suffering from an invasive infection (Annex, 2004). Rare manifestations of *C. jejuni* infections include meningitis endorcarditis and septic abortion.

Increased risk: Elderly, very young or people with underlying illness or with decreased immunity as, for example, people with immoglobulin deficiencies.

An analysis of mortality associated with infections caused by *Salmonella, Campylobacter, Yersinia enterocolitica* and *Shigella* was carried out by Helms (2004). The study adjusted for pre-existing illness and showed that the relative mortality, within one year, was 3.10 times higher in patients compared with a matched sample of the general Danish population (Helms, 2004). The relative mortality within 30 days of infection was high in all four bacterial groups. Furthermore, an excess long-term mortality was seen from six months to one year after a *Campylobacter* infection (Helms, 2005).

Sources of human infections

Campylobacter was first associated with human illness in 1972, but had been known by veterinarians since the early 1900s as causing spontaneous abortions in cattle and sheep (Skirrow, 1998). The genus *Campylobacter* contains 16 species. Although most of the species have been isolated from humans, the most important for public health

are the thermophilic *Campylobacter*, predominantly *C. jejuni* and *C. coli* (Neimann, 2001, On, 2001).

Campylobacter is widespread in nature – the principal reservoirs being the alimentary tracts of wild birds and domesticated animals, especially poultry (Skirrow, 1998). As a result of the widespread occurrence of *Campylobacter* spp. in nature and in animals, the bacteria can readily contaminate various foodstuffs. *Campylobacter* spp. may be transferred to humans by direct contact with contaminated animals or animal carcasses or indirectly through ingestion of contaminated food or drinking water. In industrialised countries, campylobacteriosis is mainly a food-borne disease.

Poultry meat products appear to be a major source of campylobacteriosis through cross-contamination to ready-to-eat foods and hand-to-mouth during food preparation, and to a lesser extent through consumption of undercooked poultry meat (Annex, 2004). Barbecuing poultry, pork and beef has been shown to be risk behaviour. Other sources include meat from pigs and ruminants, raw milk, and drinking water[13] (Neimann et al., 2003). In Denmark, the incidence of *Campylobacter* in humans has a distinct seasonal distribution, with a summer peak in June-September (Annual Report, 2004), which corresponds to the seasonal distribution of *campylobacter* in the chicken flocks and also with the barbecuing season.

Data on travel history is currently not reliably recorded in the surveillance system; therefore, the true incidence of people infected outside Denmark is unknown. It is estimated that approximately one third of cases are travel related (Annual Report, 2004).

The infective dose seems to be low, and infection has been induced by as little as 500 bacteria (Skirrow 2000). Freezing is known to decrease the number of *Campylobacter* bacteria considerably, but does not eliminate them completely. *Campylobacter* are sensitive to heat and irradiation and will readily be inactivated during cooking.

[13] The consumption of raw or inadequately heat-treated cow's milk has caused major outbreaks of C*ampylobacter enteritis* both in England and in the US (Skirrow, 1998).

Costs of Campylobacteriosis

Campylobacteriosis represents an important public health problem with a considerable socio-economic impact in the EU (EFSA, 2005). The overall social costs of decreased life quality caused by illness are very difficult to assess. However, it is possible to obtain an impression of the magnitude of the costs by considering the public health costs, including the costs of health services and the costs of lost productivity[14]. This method of estimating benefits of food safety is called the cost-of-illness method. It should be emphasised, however, that the public health costs do not include cost of illness in terms of pain and suffering, lost leisure time, the cost of preventive actions, resources spent on research, etc. (Buzby et al., 2005). Furthermore, social and psychological expenses are typically not included in the economic calculations. The clinical manifestations directly and instantly affect the quality of life among patients and their surroundings, which often will be the closest family. Infected children need to be looked after for a shorter or longer period and they might have quarantine from the school or day-care until a negative stool sample is available. If a member of the family is hospitalised it will cause anxiety, especially if the member is a child or an elderly member of the family. Zoonotic infections can be difficult to treat medically, which also can be psychologically demanding for the family and other surroundings.

In 2001, 4,620 cases of campylobacteriosis were registered. Of these, 80% was assumed to be food-borne. Based on assumed registration rates of 5%-20%, there were 18,000 – 74,000 cases of food borne related *Campylobacter* infections in 2001. The total estimated amount of days lost through illness was 87,000 – 253,000 days. In 2001, the cost for one hospitalised patient with gastroenteritis was estimated to be 19,804 DKK, and the costs of an operation were estimated to 75,940 DKK. These costs do not include costs arising in connection with GP consultations, laboratories, medication or lost working days. Based on this information, Korsgaard et al. (2005) estimate the public health costs of hospital expenses and lost productivity due to campylobacteriosis to between 88 and 235 million DKK.

Another way of measuring costs of illness is to use disease-adjusted life years (DALYs). Although the incidence of sequela is comparatively low in terms of disease burden, campylobacteriosis sequela are important measured as DALY's. A study by Havelaar et al. (2000) estimated the Dutch health burden from campylobacteriosis to be 1,400 DALYs, of which acute gastroenteritis constituted 440, residual symptoms

[14] Lost productivity is often approximated by using the value of lost earnings.

of Guillain-Barre´syndrome 340, with the remainder being linked to increased mortality.

So even though the pathological picture of campylobacteriosis can be light for the individual, the picture for society as a whole must be considered important.

How to avoid campylobacteriosis

Campylobacteriosis can be avoided with good kitchen hygiene. The Danish Consumer Council formulated a list of advice in "Think" (2001) and advice is also found on www.foedevarestyrelsen.dk (Danish Veterinary and Food Administration). Good kitchen hygiene involves:

- Bringing the chicken quickly into the fridge in the home (correct storage)
- Cooking and boiling the chicken until the meat juice is clear – all bacteria die at 75 degrees Celsius
- Keeping raw and cooked food separate
- Using different chopping boards for different purposes and washing hands and knives thoroughly
- Using paper for wiping up meat juices – never a kitchen cloth or towel that is used for other purposes
- Wash kitchen cloths and towels at a minimum of 60 degrees Celsius

It appears that young people between 20 and 30 are particularly exposed to the infectious disease, and the reason is bad kitchen hygiene. The Danish Ministry of Food, Agriculture and Fisheries has launched a campaign to inform young people about the importance of good hygiene in the kitchen. The campaign used advertisements in youth magazines, radio advertising, banner advertising on the Internet, posters at educational establishments and in gentlemen's lavatories at cafés and cinemas. Consumers could also find food hygiene advice on flyers at most convenience stores (www.fvst.dk, 2005).

Action plans towards monitoring and control

In 2003, the Danish Ministry of Food, Agriculture and Fisheries adopted a strategy against *Campylobacter*, which as a first step focused on *Campylobacter* in broilers (Anonymous, 2004). The strategy was developed in collaboration between the Danish Food and Veterinary Administration (DVFA), The Danish Institute for Food and Veterinary Research (DFVF), the Danish Consumer Council and the Danish Poultry Meat Association (DPC). It is a voluntary strategy and no regulations concerning *Campylobacter* have been prepared. The plan includes three steps:

- Reducing the prevalence of *Campylobacter* infected flock entering slaughterhouses by improving biosecurity and hygiene measures at the farm. In 1998, an economic incentive was introduced by the industry rewarding farmers supplying campylobacter-free chicken. The bonus was increased in 2003 to around 25,000 DKK per campylobacter-free flock.
- Reducing the number of *Campylobacter* in broiler meat after slaughter. In 2003, it was attempted to allocate negative flocks to production of fresh chilled products and positive flocks to production of frozen products. Two of the main slaughterhouses (Danpo and Rose Poultry) practise logistic slaughtering i.e. campylobacter-positive flocks are sent to one slaughterhouse and campylobacter-free flocks are sent to another slaughterhouse.
- Preventing cross-contamination in domestic kitchens by educating consumers. A campaign directed towards younger people was implemented in 2003.

Effect of the action plan

A reduction in campylobacter-free flocks has been detected from 43% in 2002 to 27% in 2004[15]. Further, a reduction in human infections was seen from 2002 to 2003, but it increased again in 2004, so the picture is not clear[16]. The reduction in human cases is likely to be due to the allocation of campylobacter-free chicken to chilled products, although the separation is not completely consistent and that the effect of this allocation is strengthened by the lower prevalence of positive flocks.

The prevalence of *Campylobacter* has a distinct seasonal distribution– in July and August 2004, more than 50% of the flocks were *Campylobacter* positive while the average over the year was 27%[17]. Therefore, it is has not been possible in a voluntary action plan to freeze 100% of positive flocks. Freezing a chicken product decreases the number of *Campylobacter* bacteria considerably, but does not eliminate them. In 2004, around 18% of the chilled products in the two major slaughterhouses were *Campylobacter* positive (a little lower prevalence for frozen chicken products).[18]

[15] Anonymous (2005), Figure 19.
[16] Anonymous (2005), Figure 15.
[17] Anonymous (2005), Figure 17.
[18] Anonymous (2005), Figure 18.

Campylobacter vs. Salmonella

As *Campylobacter* and *Salmonella* are the two major sources of food borne zoonoses in Denmark, it is difficult to describe *Campylobacter* without comparison with *Salmonella*. Some of the similarities and dissimilarities are gathered in Table 2.1

Table 2.1. Similarities and dissimilarities of *Campylobacter* vs. *Salmonella*

	Campylobacter	*Salmonella*
Human infection symptoms	See Box 2.1	Similar Guillain-Barré syndrome is only seen in connection with *Cambylobacter* infections
Registered number of human infections in 2004 in Denmark	69 per 100,000 inhabitants	28 per 100,000 inhabitants
Main source of infection	Broilers	Eggs, pork and broilers
Infection dose	Small	Large
Robustness	Not robust - bacteria die in dry surroundings as for instance on egg shells	Robust
Percentage flocks infected in 2004 (average over all production types).	27%	1.5% in broilers productions 0.8% in eggs production[19]
Source of animal infections	Primary sources not well known. Faecal contamination of the environment may be spread by insects such as flies, by equipment, boots if biosecurity measures are not enforced.	Same as campylobacter. Furthermore, contamination from parent flocks is a main source of infection
Action plans	Voluntary agreement between DPC and DFVA	Legislation implemented and enforced by DFVA
Handling advice to consumers	Keep risk foods cool, separate and cook well	Keep risk foods cool, separate and cook well

[19] Anonymous (2005) p. 13.

2.2. Animal Welfare

The focus of this study is on poultry production. This can be divided into production of broilers and table eggs. There are two main types of production systems in broiler production[20] (organic and indoor productions) whereas there are 4 main production types in the table egg production (organic, free-range, barn yard, and battery [21]). No broilers are produced in batteries but there are other differences between organic and conventional indoor breeding systems – some of them are highlighted in Table 2.2.

Table 2.2. Broiler production – different systems

	Organic	Conventional (indoor breeding)
Live broilers per m2 indoor	10 broilers or 21 kg live weight	20-23 (or max 44 kg per m2). From 1. January 2006, it is max. 40 kg
Outdoor access	Yes from 6 weeks of age	No
"Life time"	At least 81 days	38-42 days
Requirement of organic food	At least 80%	No
Genetically modified fodder allowed	No	Yes
Light in barn	Daylight	Light programme
Requirement of access to sand bathing	Yes	No
Requirement of perches ("siddepinde")	Yes	No
Requirement for use of slow growing breed	Yes	No
Batteries used	No	No
Size of outdoor area	??	0
Max. flock size	4,800	40,000 or no limit

Source: www.okologi.dk.

As Table 2.2 shows, significant differences in the production systems are apparent– but the consequences for animal welfare are not clear. The breeds used for conventional broiler production can, under favourable conditions, grow to around 2 kg in 40 days. As a consequence of such rapid growth, more than 20% suffer from leg prob-

[20] There is a 'Bornholmer' chicken, where the chickens are older (and thereby larger) when slaughtered. A few smaller farm-outlets sell 'free-range' chickens where outdoor access is part of the brand (Frilandskyllingen). Furthermore, the productions of 'fritgående kylling' which has outdoor access and more space than the standard barn yard chicken and 'skrabekylling' which has more space than the barn yard chicken – have been shut down.

[21] In Danish: økologisk, fritgående, skrabekyllinger, bur.

lems. In contrast, slow growing races, such as the ones used in organic farming, grow to only a fourth of that weight in 40 days. In order to prevent too fast a weight gain, the authorities introduced "*The light programme"*. This programme restricts the number of hours that light may be turned on in the broiler houses. This provides the broiler with a number of hours for rest. However, if the resting period is too long the animals may suffer from acid burns on their footpads, i.e. lesions/burns of the skin underneath the feet, because they stand in the same spot for too long. Approximately 30% of the birds experience feet-problems. Organic broilers have more space than conventionally bred broilers which reduces cannibalism and feather pecking. Also, beak trimming is not allowed which would seem to bee a humane restriction. However, the banning of beak trimming in organic chickens results in higher mortality in organic flocks due to increased cannibalism.

Overall, it is generally believed that organic chickens have higher welfare than conventionally-bred chickens, taking into consideration the pros and cons in both production systems. Table 2.3 describes some of the pros and cons with respect to animal welfare of the two different production systems, and is followed by a more detailed description of the differences.

Table 2.3. The welfare implications of organic broilers compared to conventional broilers

	Pros (advantages) of organic production	Cons (disadvantages) of organic productions
Stocking density	Due to the lower stocking density in organic broiler production, compared with conventional production, the animals have more individual space, which, in turn, results in lower levels of stress. Stressed animals may secrete more bacteria than non-stressed animals. Due to more space for movement, cannibalism is less frequent.	The natural flock size for chickens is 10 – 14 individuals per flock. So even though the stocking density in organic poultry is low compared with conventional production, the flock size is unnaturally large and will influence natural behaviour.
Outdoor access	Access to outdoor areas supports the physiological and natural behaviour pattern of the animals. The birds can sand bathe, scrape and have free movement, which among other things prevents leg problems.	Higher prevalence of pathogenic zoonoses, e.g. *Salmonella* and *Campylobacter*.
Free-range system	Free movement supports natural and physiological behaviour	
Bedding	Quality of bedding is of great importance for the welfare poultry, since the animals spend their entire life in contact with bedding. The bedding supports the instinct for scraping and pecking.	Poor bedding quality is recognised as a welfare problem in modern broiler production. The quality of bedding affects the environmental situation of the birds by influencing e.g.: Dust levels, air humidity levels and occurrence of ammonia burns.
Perches	Part of natural behaviour for some breeds of poultry. Good potential for reducing bird density at floor level and reducing ammonia burns.	Can cause breast blisters in some breeds of poultry. A breast blister is a lesion of the skin on the breast, varies in size and is full of fluid and blood.
Beak trimming	Beak trimming is not allowed. Beak trimming is painful for the chicken and prevents natural behaviour, such as pecking in the earth for food.	In conventional production systems, beak trimming is used to reduce feather pecking, pecking and cannibalism. This measure for reducing pecking etc. is not allowed to use in organic productions.

Feed

Organic feed is produced in consideration of the environment, without use of fertilisers and pesticides. GMO feed is not allowed in the production of organic poultry. Whether these feed parameters are pros or cons must be a matter of the consumers' individual principles, since there is no proven impact on the well being of the poultry.

Perches

According to the Report of the Scientific Committee on Animal Health and Animal Welfare of the European Union 2000, the chickens rarely use the perches. With higher densities the perches are used but, whereas some birds use them frequently, others never use them at all. A large individual variation in the use of the perches can be related to leg weakness. The use of the perches commences at the age of 6 weeks or older (42 days) (Anonymous, 2000). Perches have a good potential for reducing bird density at floor level and reducing ammonia burns on the footpads.

In Denmark, organic poultry has access to perches. However, the higher incidence of breast blisters in organic poultry, caused by perches, may bring their advantages into question. According to a study, carried out by senior-scientist Birte Lindstrøm Nielsen, Danish Institute of Agricultural Sciences, the incidence of breast blisters was estimated as affecting 7% of organic poultry production. Although the study did show that breast blisters might be associated with perches, the study also found that a high frequency of breast blisters is more likely related to breed and sex of the poultry. Some slow growing breeds are more likely to develop breast blisters than others (Nielsen, 2004). This might cause problems in organic production, where slow-growing breeds are used.

Light programs and leg problems

Traditionally, broilers have been reared in near continuous light in order to maximise food intake and daily weight gain. In 1999, periods of darkness were introduced in the poultry houses. Investigations showed that the legs of the poultry would grow stronger if the poultry were allowed to rest. Before 2001, prior to the implementation of "The light programme", there were no regulations concerning periods of darkness in Danish poultry production.

In 1999, 30% of broilers had leg problems, 5.8% (7.9 millions broilers) were unable to walk on their own. In 2005, these figures were reduced to 13% with leg problems, of which 0.5% (653,000 broilers) had difficulty standing up. Within 38 – 40 days a conventional broiler grows from an initial 40 grammes to a final slaughter weight of 2 kg. Under more normal conditions (e.g. organic production), this takes approximately 80 days (Danish Agricultural Advisory Service, 2001). The rapid growth rate has a significant impact on the skeleton of the broilers. It is obvious that rapid growth rate, which is a result of genetic selection, along with intensive feeding and management systems, are the main causes of various skeletal disorders and metabolic diseases. These factors all influence the mortality rate within poultry flocks (Anonymous,

2000). A clear relationship was found between body weight and mortality, in particular in relation to mortality caused by the Sudden Death Syndrome (SDS). Slow growing breeds show lower mortalities as compared to conventional broilers, when reared under similar conditions. Various management factors, such as lighting programmes and feeding measures can reduce early growth and obviously reduce the level of mortality in conventional broilers (Anonymous, 2000). According to Danish Agriculture and The Danish Institute of Agricultural Sciences[22], however, longer periods of darkness can, in fact, increase the stress level of the broilers. The broilers will become so stressed by hunger, from not eating during the dark period, that fighting over the feed leads to increased pecking and scratching.

Stocking density

Stocking density has become a major issue in the debate on broiler welfare. Very high density may not only influence the welfare of the birds through physical restriction of movement, but also through the quality of bedding in the broiler house. Poor bedding quality, high ammonia levels and heat also have an impact on welfare. In order to ensure optimal climate within the broiler houses, ventilation must be adjusted according to stocking density (Anonymous, 2000).

Bedding and ammonia burns

In the Danish broiler production, bedding is not renewed during the broiler's lifetime. In general, high stocking density can lead to wet bedding and high ammonia concentrations, which in turn can lead to ammonia burns, contact dermatitis and breast blisters. The wet bedding can also lead to parasitic infestation (Anonymous, 2000). Good management procedures ensuring dry bedding have been shown to reduce ammonia levels and mortality in the flocks. Ammonia burns are very painful for the broilers, as it causes open wounds underneath the footpads of the birds. The constant level of ammonia will continue to burn the wound, preventing healing and cause secondary bacterial infections of the feet.

Ammonia is formed during decomposition of uric acid; has a sharp and pungent odour; and can irritate eyes, throat and mucous membranes in both humans and farm animals. Although it is lighter than air, it rises slowly through the building, eventually to be removed through the ventilation system. Ammonia levels are affected by a

[22] www.dansklandbrug.dk, 13.02.2006, www.agrsci.dk, 13.02.2006.

number of factors, such as temperature, ventilation rate, humidity, stocking density, bedding quality, and feed composition (Anonymous, 2000).

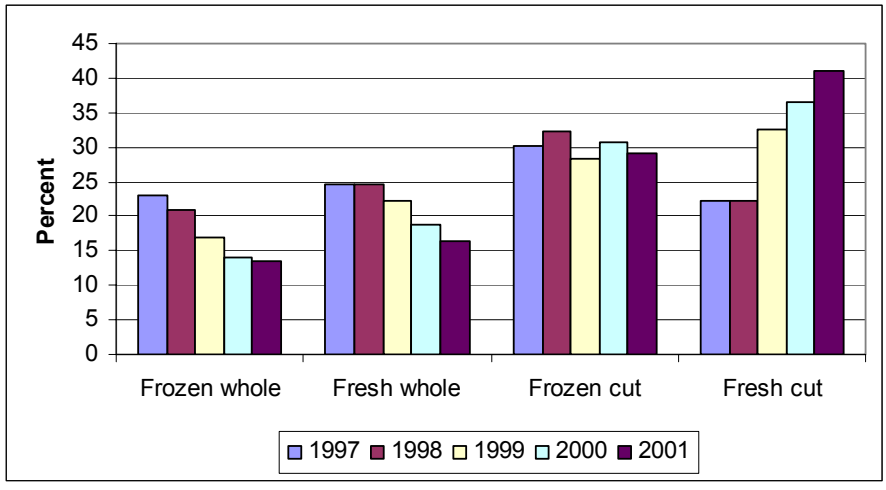
Light programmes and ammonia burns
The natural sleeping pattern of broilers requires the birds to have a continuous dark period of no less than 4 – 6 hours per 24 hours (www.agrsci.dk, 13.02.2006). Leg problems can be reduced with 4 hours continuous darkness. However, there is no benefit in increasing this period to 8 hours of darkness. On the contrary, both Danish and Dutch studies shows have shown that longer periods of darkness will increase the risk of ammonia burns and other problems associated with ammonia (www.agrsci.dk, 13.02.2006).

2.3. Market conditions

The consumption of chicken has increased rapidly over recent decades – from around 6 kg in 1973 to 15 kg per inhabitant in 2002 (Graversen, 2003). The development in budget shares for the four main categories of chicken products (chilled, frozen, processed or whole) over the period 1997-2001 is shown in Figure 2.2. The largest increase is seen for chilled processed chicken meats (GFK 2001). The imports cover an increasing share of the Danish consumption – more than 25 % in 2004 (Dansk Slagteri Fjerkræ 2005 and Statistics Denmark).

Only a very small part of the market (less than 1%) consists of production with special emphasis on animal welfare – the main markets are standardised chicken products. This is in sharp contrast to the egg sector where around 60% are battery eggs whereas the remainder are the result of special production systems (Graversen, 2003).

Figure 2.2. Budget shares of chicken meat products, in Denmark,1997-2001



Source: GFK household panel data
Note: Cut includes 'cut and further processed products'.

One of the main chicken slaughterhouses, Lantmännen Danpo[23], has introduced the following special production features to the market:

- In 1995, a chicken with more living space and a longer life[24]. This "welfare chicken" never became a success and was redrawn from the market again in 2001.
- In 1996, a *Salmonella*-free chicken.
- In 2000, a *Salmonella*- and *Campylobacter*-free chicken (frozen).
- In 2003, a *Salmonella*- and *Campylobacter*-free chicken (chilled).

Today, all Danpo chickens are *Salmonella*-free, but only 1% are also *Campylobacter*-free.

An overview of the relationship between the prices of different products is provided in Table 2.4 (based on scanner data from COOP over the period 2000-2002). It can be seen that the price premium for a campylobacter–free chicken is just over 2 DKK,

[23] There are two main chicken slaughter houses in Denmark who cover 98% of the markets: Rose Poultry and Rose Poultry and Lantmännen Danpo.
[24] In Danish, "skrabekyllingen".

which is not very much. The price premium for an organic chicken on the other hand is considerable.

Table 2.4. Average demand for chicken

	Price per kg (DKK)	Share of poultry budget
Whole frozen	21.96	11.5
Cut frozen	29.52	33.5
Whole chilled	32.11	12.6
Cut chilled	66.66	36.4
Campylobacter-free (whole frozen)	25.25	4.3
Organic	56.64	0.8
Barn yard (withdrawn from market in 2001)	37.90	0.9
Total		100

Source: Jensen et al. (2004), Table 4.13 based on scanner purchase data from COOP in the period 2000-2002. COOP includes OBS, Kvickly, SuperBrugsen, DagliBrugsen, LokalBrugsen and Irma. The price relations between (see also Baltzer, 2004, for a market analysis on chicken products based on COOP scanner data).

Based on these market observations, it can be concluded that the markets for food safety and animal welfare exist. However, the markets are probably too small to secure a pricing mechanism that ensures that the market prices reflect the actual consumers' willingness to pay. Hence, a stated preference analysis will support the information provided by the market analysis.

3. Economic valuation of non-market goods

3.1. Introduction

The central purpose of the theory of consumer choice is to explain the allocation of the consumer's income (or wealth) among the myriad of commodities which may be purchased in an advanced economy. The classical consumer theory of the nineteenth century was built on the assumption that each consumer associates, with any given consumption bundle, the corresponding degree of satisfaction, or utility, which results from the consumption of that bundle. The problem of consumer choice may then be interpreted as the maximisation of the consumers' utilities, subject to the constraint that the consumers do not spend more income than they possess (Russell & Wilkinson, 1979, p.26).

This problem is often written in mathematical terms, where utility is a real valued function U of a bundle of consumption goods $X=(x_1, \ldots, x_N)$ that is maximised subject to a budget constraint (price vector P of the goods X and Y is income). This can be written as:

$$\text{Max } U(X)$$

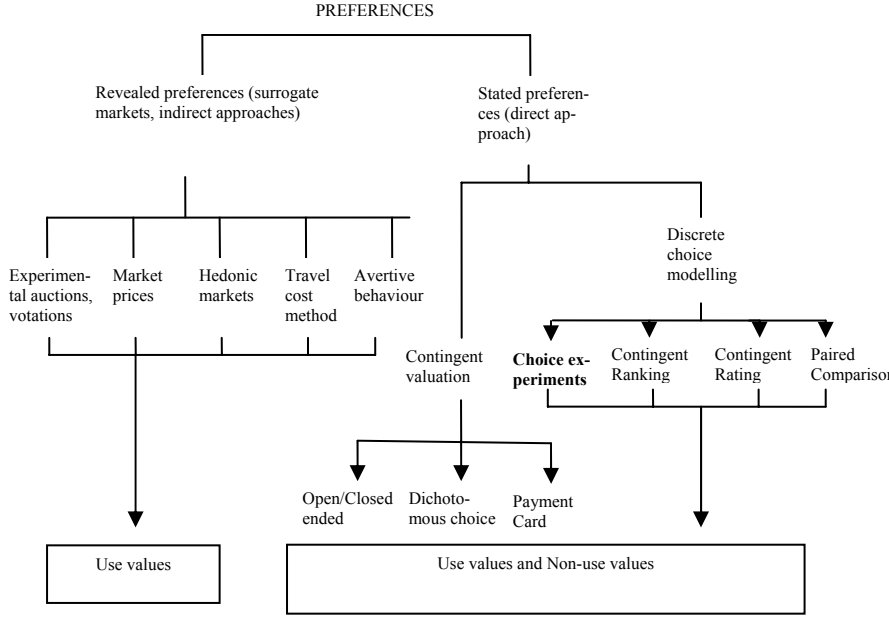
$$\text{Subject to } PX \leq Y$$

Hence, the consumer's problem is to find the optimal consumption bundle X^*. Different prices, will lead to different optimal consumption bundles. In particular, the function that describes the optimal consumption bundles as a function of prices $X^*(P)$ is called a demand function. Typically, the demand for a good x^* is a decreasing function of its own price. When the market for a good has settled in equilibrium, where supply equals demand, then the marginal willingness to pay for a good equates to its market price. However, when a good is not traded in the market, other methods for eliciting consumers' preferences are required. This chapter focuses on valuation of non-marketed goods.

Economists have developed a whole array of techniques to estimate economic values of goods that are not, or are only indirectly, sold on markets. The techniques can roughly be divided into revealed preference methods (see Section 3.2) and stated preference methods (see Section 3.3). The focus here is on stated preference methods and, in particular, choice experiments, i.e. the method that has been chosen for valu-

ing animal welfare and food safety in the present study. In Section 3.4, the theoretical foundation for estimating consumer behaviour and eliciting willingness to pay estimates using choice experiments is described. Section 3.5 contains a detailed description of the choice experiments method. Discussions of choice experiments can roughly be divided into topics related to the design of the experiment and to the data analysis. Attention has been focused on describing the design phase, which is concerned with producing reliable data. The most important issues are discussed, starting with the choice of attributes, followed by a discussion of the experimental design which covers the phase from attributes to alternatives. Finally, the phase from alternatives to choice sets is discussed. The data analysis, which aims at extracting as much information and as reliable estimates as possible from the data[25], is discussed in Chapter 5 and in Appendix G. Figure 3.1 provides an overview of the different economic valuation methods that are touched upon in this chapter.

Figure 3.1. Overview of economic valuation methods



Source: Inspired by Garrod & Willis (1999).

[25]This involves choice of econometric model and estimation procedure.

3.2. Revealed preference methods

Revealed preference methods are based on market data. As consideration is given to characteristics that are not, or only indirectly, traded, these data will provide indirect information about the characteristics in question. The methods reveal how much consumers *indirectly* value the non-market good. The *travel cost* method is one of these methods, using the expenses for the complementary good "travel" to estimate a demand curve for the good in question (e.g. a recreational site). The maximum costs that individuals are willing to spend on obtaining a certain good are used to estimate a trip generating function, from which the value of the good is derived. The *hedonic price method* is based on the consumer theory of Lancaster, which states that any good can be described in terms of its attributes and the levels that these take (Lancaster, 1966). Typically, in hedonic pricing, the compound good used is houses and the good to be valued is an environmental issue. For discussion of the methods, see for example Garrod & Willis (1999) and Bateman et al. (2002).

Experimental auctions are a valuation method whereby a group of people is given an endowment of money or goods. Subsequently, an experiment is performed where a real auction takes place. In a typical experimental auction setup, the participants bid to obtain a good. The basic idea is that the highest bidder wins the auction and pays a price that is determined exclusively from the bids (Kimenju et al., 2005). Experimental auctions can be designed in different ways using more refined bidding mechanisms such as sealed bids, second highest sealed bids, etc. For use and discussion of the method, see Hayes et al. (2002), Hayes et al. (1995), Rozan et al. (2004) or Kimenju et al. (2005). Auctions differ from other methods (both revealed and stated) in the way that the consumer actively participates in the price setting. In Figure 3.1, an *experimental auction* is categorised as a revealed valuation method according to Garrod & Willis (1999). The present authors argue that it could just as well have been categorised as a stated valuation method, because although the transactions are real – they are performed in a controlled setting where the researcher must expect the consumers to have a different focus than in a normal shopping situation.

The *Averting Behaviour* approach places a monetary value on an externality by observing the costs people are willing to incur in order to avoid any negative effects (Garrod & Willis 1999). With respect to food safety, an averting behaviour could be the costs in terms of extra kitchen hygiene and the care that a consumer would have to exercise in order to avoid infections from an infected product. It could also be the extra costs of buying a product free from harmful bacteria.

Pros and cons of revealed preferences

Revealed preference methods have the obvious advantage over stated preference methods of being based on actual choices and observations in the market. However, as a drawback, revealed preference methods are only suited for estimating the *use* value of goods. The *non-use* values such as existence, bequest and option values can not be valued through the markets for related goods[26], except for experimental auctions where the good can be characterised by both use- and non-use values. Another limitation of revealed preference methods is that they are only suited for valuing existing attributes. When no related goods exist in the market or when the markets do not fulfil the above-mentioned requirements, stated preference methods provide alternative ways of determining the demand for the attributes/non-market goods.

3.3. Stated preference methods

Stated preference methods can be used to estimate the demand for non-market goods by examining consumers' stated (expressed) preferences. These can be expressed using surveys by post, phone, personal interview, electronic mail/internet, etc. A common feature and advantage of stated preference methods, is that respondents can be presented with a hypothetical scenario, which is designed to the exact purpose of the analysis (cf. Kuhfeld 2004 etc.). Thereby, a *direct* measure can be obtained of the value that consumers place on a particular attribute/product. The stated preference methods include the *contingent valuation method (CVM)* and the *discrete choice modelling (DCM)* method (Garrod & Willis 1999; Bateman et al. 2002; Alpizar et al. 2003). These methods are described in the text below, with special emphasis on describing the characteristics of a special case of discrete choice modelling, namely choice experiments (CE).

Contingent Valuation (CVM)

In CVM, a good is described in a scenario and the respondents are asked to state their willingness to pay for the good. There are several ways to set up the contingent valuation format according to the recommendation (see, for example, Arrow et al. 1993). By means of open-ended formats, respondents are asked to state their maximum willingness to pay, in contrast to the closed-ended formats, where the respondents are presented with prices which they have to accept or reject. Several other closed-ended elicitation formats have been developed, and among these the *payment card method*

[26] Non-use values of environmental goods are often related to some element of irreversibility in the availability of the good (if a species is extinct then it is not possible to value it in the future).

has become rather popular (Ready et al. 2001), where the respondents are presented with a card with a range of prices and asked to choose the price they are willing to pay.

At present, the most preferred method among researchers using CVM is the closed-ended *dichotomous choice* approach in which respondents decide whether or not they would purchase a good at some offered price (Burton et al.2004). By varying the price of the good across sub-samples of respondents, a demand curve for the commodity is estimated. In order to extract additional information from the respondents, a *double-bounded dichotomous choice* model is sometimes used. This setup basically consists of two dichotomous choice sets where the second choice set depends on the respondent's answer to the first. If the respondent is willing/not willing to pay the suggested amount, the second payment choice includes a higher/lower price. This second bid can also be presented in an open-ended format. For further discussion of the different questionnaire techniques, see Smith (1997).

An open-ended CVM analysis provides the researcher with a point estimate of the maximum willingness to pay (and thereby the demand) for a good for each respondent. CVM with closed-ended questions provides a range of price estimates which can be transformed into willingness to pay estimates.

In CVM, preferences for a good are valued, or the preferences for specific attributes of a good instead of the compound good, by posing additional questions concerning how the consumer values individual attributes of the compound good. However, the preferences for the attribute and the compound good are not stated simultaneously and such a procedure increases the risk of obtaining higher values for the attributes than for the entire good itself, which is known as an embedding effect. Embedding is a potential problem for all stated preference methods (Garrod & Willis 1999; Bennett & Blaney 2003). Valuing different attributes and/or different levels of the attributes requires a new (similar) CVM study to be undertaken. Hence, it is expensive to estimate the value of different product attributes using CVM. Therefore, CVM is not suited to valuation of individual attributes or to estimate trade-offs between them.

Discrete Choice Modelling (DCM)

Discrete choice modelling is a common term for *choice experiments* (CE), *contingent ranking, contingent rating* and *paired comparison* models[27]. Any closed ended question format is, in principle, a discrete choice problem. The dichotomous choice version of CVM is the simplest form of the discrete choice models (Smith 1997). However, there are two fundamental differences between CVM and discrete choice modelling. The first being, that choice modelling is based on the consumer theory of Lancaster (1966) as the hedonic pricing method. This means that a good is explicitly defined by its attributes and each combination of attribute levels describes a different good. Secondly, discrete choice modelling is based on a systematic choice design that involves a systematic changing of attribute levels. Thereby, it is possible to estimate the value of the different attributes associated with a particular good (Bennett & Adamovicz 2001; Carlsson et al. 2003).

The most popular discrete choice model is CE, in which the respondents are simply asked to choose between alternatives in sets of choices. In contingent ranking, the respondents are asked to rank each alternative within each choice set. Ranking is a more complex task for the respondent – but also a task that reveals more information about the alternatives than CE. For a discussion of contingent ranking experiments, see Foster & Mourato (2002). In contingent rating, the respondent is asked to rate all alternatives which might involve two alternatives having the same rating (Boyle *et al*., 2001 and Bateman *et al,*. 2002). Paired comparison is a discrete choice version where the respondent is not only asked to choose the most favourable alternative but also by how much it is preferred in example on a scale like weakly preferred, strongly preferred, etc. (Bateman et al*.,* 2002).

Pros and cons of different choice modelling methods

CE has been chosen for the present survey for a number of reasons:

1) The ability to handle multidimensional risks and situations where trade-offs between these risks are prevalent.
2) Respondents are asked to make choices between alternatives instead of being asked to do the much more complex task of assigning a value to various attributes, or risks, as was the case in the original contingent valuation studies (James & Burton, 2003).

[27] These models are also called attribute-based methods (Holmes & Adamovicz, 2003). Also the term conjoint analysis is sometimes used because it is required that respondents consider multiple attributes *joint*ly.

3) CE is very suitable for our purposes because the focus in the study is on attributes rather than compound products. By using CE, values for each attribute, as well as marginal rates of substitution between non-monetary attributes, can be obtained.
4) Attributes can be presented in any specific context depending on the purpose of the experiment. For example, attributes can be linked to a private good as well as to a change in policy. By forcing the respondents to focus on specific attributes (i.e. by keeping all other attributes unchanged across alternatives), it is possible to analyse attributes which individuals normally do not focus on, but which are important in a political or social welfare perspective (James & Burton, 2003; Alpizar et al., 2003).

Furthermore, there are some general advantages of choice experiments, compared with other discrete choice methods, and discrete choice methods, compared with contingent valuation methods, that strengthened our choice.

For example, CVM is found to suffer from embedding effects in the sense that respondents' willingness to pay found in different CVM studies cannot be added in order to determine the value of an aggregated good (e.g. The value of protecting/restoring 10 lakes is not the added value of protecting/restoring 10 separate lakes) (Carson et al., 2001). Discrete choice methods reduce the problem of embedding when valuing attributes of a good, because the method and how the different attributes are linked is less transparent (Carlsson et al., 2004b; Ryan & Wordsworth, 2000).

Another advantage of DCM compared with CVM is the systematic design, which implies that DCM produces more information than, for example, CVM in relation to identifying values for individual attributes and cross effects between attributes.
Within DCM, the choice task in CE is found to be less difficult than the tasks of ranking rating and comparing.

According to economic theory, CE is the only discrete choice method that can produce willingness to pay estimates that are consistent with the usual measures of welfare changes such as compensating and equivalent surplus/variation. Basically, it only requires that an opt-out option is included in the CE. Also within the contingent ranking method, it is possible to include a *status quo* option in order to interpret the results in standard welfare economic terms. However, if a respondent chooses the *status quo* as first choice in the ranking exercise, then the ranking of the remaining alternatives reflects a conditional demand. One solution is just to discard the subsequent ranking,

once the *status quo* option has been chosen, although much information is then lost (Bateman et al. 2002; Hanley et al. 2001). In the contingent rating method, two alternatives might obtain the same rating, but because the rating method does not involve a direct comparison between the two alternatives, there is no relation between the expressed ratings and the economic choices. Ratings and paired comparisons data are more difficult to translate into welfare economic terms. Strong assumptions about the cardinality of the rating scale have to be made to use a transformation function (Hanley et al. 2001, Bateman et al. 2002).

There are also disadvantages in using DCM. Burton et al. (2004) conclude that there is a limit to how much information respondents can meaningfully handle while making a choice. Also, learning - or fatigue effects can occurs leading to seemingly irrational choices, as the choice depends not only on the choice set but on when in the choice experiment the particular choice set is presented. This is a potential problem for all stated preference methods, but especially for discrete choice methods, because there are always multiple choice sets and they are often presented to the respondent in a more complicated way than in a CVM question.

Identification of relevant attributes and levels is another challenge in discrete choice models. Not just one realistic level must be identified, as in the CVM, but several levels have to be found in order to estimate the value of the attributes in question. If the most relevant attributes for defining a particular good are not identified, this could result in biased estimates, due to for example an embedding effect (Bennett & Adamowicz, 2001).The problem can be reduced by use of pre-questionnaire analysis and focus groups, see for example Powe *et al*. (2005).

Carlsson et al. (2004c) argue that also individuals who do not consume these goods might have preferences towards or against the good. The preferences of this group of individuals cannot be included in a survey. Therefore, this may result in an underestimation of the benefits (Carlsson et al., 2004c). This is a general critique of the stated preference methods when valuing market goods and should be kept in mind when drawing conclusions based on economic valuation data. Bennett (1995) also discusses the issue of how to include the demand of non-users in the valuation of non-market goods in relation to animal welfare.

The choice experiment method is described in greater detail in the following section and a general discussion of the choice experiment method is found in, for example,

Bateman et al. (2002), Louivere (2001), Louviere et al. (2000), Lancsar & Savage (2003), Hanley *et a*l. (2001), Caussade *et al*. (2005), and Alpizar et al. (2003).

3.4. The theoretical foundation

The theoretical foundation for using choice experiments for economic valuation is based on Lancaster's consumer theory and random utility theory. A short presentation of the two theories is given below.

3.4.1. Lancaster's consumer theory

Lancaster's Consumption Theory (LCT) also provides a theoretical framework for understanding consumers' choice of goods. The main difference from the conventional theory is that LCT assumes that a good is a bundle of attributes or characteristics and, therefore, the consumer demands attributes. In traditional theory, on the other hand, the consumer is assumed to demand goods *per se* (Lancaster, 1966).

In LCT, consumer preferences are defined in relation to bundles of characteristics and the demand for goods is a derived demand. Consumption is the activity of extracting characteristics from goods (Gravelle & Rees, 1992). According to Lancaster, the utility that individual i achieves from good j (V_{ij}) is the sum of the utilities obtained from each of the K characteristics s_{ijk} for $k=1,...K$. Assuming linearity, the indirect utility of alternative j for individual i is:

$$V_{ij} = \beta_1 s_{1ij} + \beta_{2j} s_{2ij} + ... + \beta_{Kj} s_{Kij} \tag{3.1}$$

where s_{kij} is the level of attribute k in alternative j faced by individual i, and K is the number of attributes. Each attribute s_k for $k=1,..,K$, can take on L_k possible values corresponding to the predetermined attribute levels.

The parameter β_{kj} represents the weight by which attribute k in alternative j is valued (Holmes and Adamovicz (2003) denote β_{kj} a *preference parameter* associated with attribute k in alternative j). For simplicity, it is assumed that the weight β_k is independent of alternative j.

3.4.2. Random utility theory

Random utility theory (RUT) derives from Luce (1959) and McFadden (1973). The hypothesis of random utility theory is that individuals make choices according to a deterministic part that depends on the attributes of the alternative along with some degree of randomness (a random component). Allowing U_{ij} to represent the utility function, V_{ij} is the deterministic component and ε_{ij} is the stochastic component (noise) of the individual's choice, i refers to individuals and j to alternatives (Hanley *et al*., 2002). Then individual i's utility of alternative j can be written as:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{3.2}$$

The RUT formulation of utility in Equation (3.2) also corresponds with the notion that the researcher only has partial knowledge of the real structure of individuals' preferences. Using this formulation, U_{ij} represents the true but unobserved indirect utility function, V_{ij} is the observed component, and ε_{ij} is the unobserved component of the individual's choice. The latter is assumed to behave stochastically, because it represents the researcher's uncertainty about the choice (Holmes and Adamovicz, 2003, p. 188).

For convenience, it is assumed that the observed part of the individual's utility function is additively separable and linear in attributes. Assuming further that alternative j is described by K attributes, the observed component can be inserted in LCT in the equation (3.1), and the utility of individual i of alternative j can be written as:

$$U_{ij} = \beta_1 s_{1ij} + \beta_2 s_{2ij} ..... + \beta_K s_{Kij} + \varepsilon_{ij} \tag{3.3}$$

or using vector notation, the utility can be written as

$$U_{ij} = \beta' s_{ij} + \varepsilon_{ij} \tag{3.4}$$

where β' is a K dimensional vector of attribute preference parameters.

Interactions between attributes

If interactions between attributes are included in the experimental design, the utility function can be specified as (Holmes and Adamowicz, 2003, p 189):

$$U_{ij} = \sum_{k=1}^{K} \beta_k s_{kij} + \sum_{k=1}^{K} \sum_{\substack{m=1 \\ m \neq k}}^{K} \beta_{km} s_{kij} s_{mij} + \varepsilon_{ij} \tag{3.5}$$

Individual specific variables

Lancaster's theory is based on the assumption that a good is completely characterised by its characteristics. However, the utility that an individual retrieves from a good depends not only on its attributes but also on socio-demographic characteristics as well as the personality of the individual, social norms, etc. Hence, a model that describes consumer behaviour should also include variables that are not related to attributes, but to individuals (socio-demographic or attitudinal variables).

Let us now assume that the utility of alternative *j* is a linear function of not only *K* attributes related to alternative *j* (s_{jk}) but also *M* individual characteristics (y_{im}), $s_{ij} = (s_{j1}, \ldots, s_{iK}; y_{i1,\ldots,} y_{iM})$. Hence, the random utility function can be written as:

$$U_{ij} = \sum_{k=1}^{K} \beta_{jk} s_{jk} + \sum_{m=1}^{M} \delta_{im} y_{im} + \varepsilon_{ij} \tag{3.6}$$

where β_j is the preference parameter for attributes and δ_m is the preference parameter for individual characteristics. Of course, the interaction model (3.5) and the model which includes individual specific variables (3.6) can be combined.

3.4.3. Willingness to pay

An important issue in economic analysis of consumer choice behaviour is to obtain estimates of the willingness to pay estimates for certain attributes. If the random utility function is assumed to be additively separable and linear in attributes, then the estimated preference parameter for attribute k (β_k) represents the marginal utility of attribute k. Furthermore, marginal rates of substitution between any two attributes *m* and *k* can be computed as the ratio of the parameter estimates $MRS_{km} = \beta_k / \beta_m$. The parameter estimate of the price attribute β_p has a special status since MRS_{kp} is the marginal value of attribute *k* per DKK. This ratio between the β coefficients is known

as the implicit price (Hanley *et al*. 2002) - also denoted as the willingness to pay. This can easily be shown when the unobserved utility is formulated as:

$$U_{ij} = \beta_1 s_{1ij} + ... + \beta_k s_{kij} + ... + \beta_p s_{pij} + ... + \beta_K s_{Kji} + \varepsilon_{ij} \quad (3.7)$$

Then, the marginal utility of attribute *k* is calculated as:

$$\partial U_{ij} / \partial s_{kij} = \beta_k \quad (3.8)$$

And the implicit value or willingness to pay is calculated as:

$$\frac{\partial U_{ij}}{\partial s_{kij}} \Big/ \frac{\partial U_{ij}}{\partial s_{pij}} = \frac{\beta_k}{\beta_p} \quad (3.9)$$

If interaction effects are present between attributes *k* and *m*, then the marginal utility of attribute *k* depends on the level of attribute *m*, for example:

$$\partial U_{ij} / \partial s_{kij} = \beta_k + \beta_{km} s_{mij} \quad (3.10)$$

3.4.4. From choice experiments to probabilistic utility

Due to the stochastic component in the utility function, a choice cannot be predicted with certainty, but only as a probability, hence the utility function is probabilistic (Garrod & Willis 1999). An important step in the analysis of the choice experiment is, therefore, the relation between the utility individual *i* obtains of a given choice *n* (U_{in}) and the probability that this choice is made (P_{in}). The RUT provides a theoretical foundation for linking the choice experiment data with consumer behaviour based on utility maximising behaviour.

The probability that individual *i* prefers alternative *n* to any alternative *j* in the choice set, can be expressed as the probability that the utility associated with alternative *n* exceeds the utilities associated with all other alternatives *s* (McFadden, 1973):

$$
\begin{aligned}
P_{in} &= P\left[\left(U_{in} > U_{ij}\right)\forall j \neq n\right] \\
&= P\left[\left(V_{in} + \varepsilon_{in}\right) > \left(V_{ij} + \varepsilon_{ij}\right)\forall j \neq n\right] \\
&= \int I\left(V_{in} + \varepsilon_{in} > V_{ij} + \varepsilon_{ij}\,\forall j \neq n\right) f(\varepsilon_n) d\varepsilon_n
\end{aligned} \tag{3.11}
$$

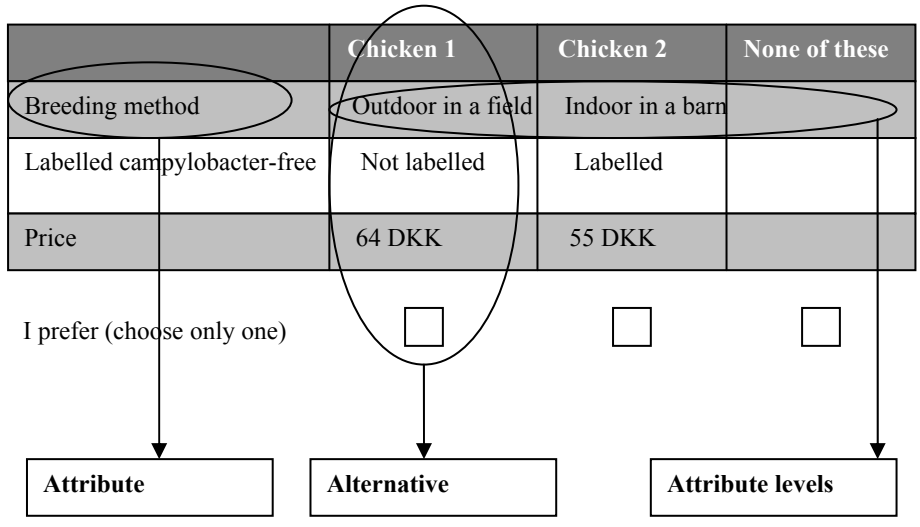
There are many ways of stating the choice probabilities. Equation 3.11 links the observed characteristics of the chosen alternative (V_{in}) and the not-chosen alternatives (V_{ij}) to the probability that alternative n is chosen. The last equation shows that the probability of individual i choosing alternative n can be written in terms of integrating over an indicator function which is 1 if the statement in the brackets is true and 0 otherwise, and a density of the error term $f(\varepsilon_n)$. The exact appearance of the above equation depends on the distribution of the random component/error term $f(\varepsilon_n)$ (Train, 1986; McFadden, 1973). A short description of the typical distributions used in discrete choice modelling is provided in Appendix G.

3.5. Description of the choice experiment method

3.5.1. Terminology

In the present chapter, the CE method is described in greater detail, as it represents the method used in this study. The basic terms involved in CE include *choice sets*, *alternatives*, *attributes* and *attribute levels.* An example of a choice set is provided in Figure 3.1. There are three alternatives: chicken 1, chicken 2, and neither of these (i.e. an opt-out alternative). The two real alternatives are characterised by three attributes: breeding method, campylobacter content, and price. These attributes can have different values (attribute levels) as, for example, a chicken can be bred outdoors or indoors, and can be labelled campylobacter–free or have no information concerning campylobacter content.

Figure 3.2. An example of a choice set



The design phase covers the process from formulating ("designing") alternatives and combining them to form choice sets. The design of choice sets involves trade-offs between statistical efficiency of experimental design, information extraction and considerations concerning respondents' cognitive abilities. The literature contains several design guidelines concerning the number of choice sets in a survey, number of alternatives in a choice set, number of attributes in each alternative and number of attribute levels. Guidelines also exist on how to describe the attributes and attribute levels, and how to group alternatives into choice sets and choice sets into blocks. Also, choosing whether and how to include cheap talk and opt-out options, etc. are issues of importance for obtaining reliable data. Design characteristics of other studies are presented in tables in Appendix B1-B3.

3.5.2. Attributes

The attribute levels should be realistic and vary over intervals which respondents are expected to have preferences towards. This reduces the risk of biased estimates due to protest answers (Ryan & Wordsworth 2000; Bennett & Adamowicz, 2001). On one

hand, the larger the number of attributes and attribute levels, the more information can be extracted from the survey. On the other hand, the cognitive burden for respondents increases with the number of attributes and their levels. It is shown that reducing the complexity may increase the response rate (Bateman et al., 2002). Furthermore, the minimum sample size required to achieve statistically significant estimates increases exponentially with the number of attributes and attribute levels (Bateman et al. 2002). Often, the number of attributes is restricted to a relatively small number such as 4, 5 or 6 (Garrod & Willis, 1999; Bateman et al., 2002).

To identify the relevant attributes used to describe a product, focus group interviews are very useful and can be conducted face to face or by telephone (Krueger, 1988). Former studies can also be used in this process.

If the purpose of the survey is to elicit willingness to pay estimates, it is vital that a price attribute is included and, in particular, that the upper limit of willingness to pay is included in the range of price levels. If the upper level is not included in the design (that is, the respondents choke price is not reached) then the price coefficient obtained will be too small (Bateman et al. 2002; Rowe et al. 1996). Bennett & Adamowicz (2001) and Bateman et al. (2002) recommend the use of a pre-test to determine price levels. Rowe et al. (1996) recommend that the maximum level of the price attribute is determined by use of a payment card.

3.5.3. Experimental design (from attributes to alternatives)

The design of experiments is concerned with how attributes and attribute levels are combined into alternatives. The larger the number of attributes and the larger the number of levels per attribute, the larger the experimental design will be. Experimental designs provide the means to select subsets of the total set of possible alternatives in an experiment (questionnaire) in a strategically efficient manner. Basically, there are two types of experimental design that combine attributes to alternatives: full factorial design and fractional factorial design (Bateman et al. 2002). The underlying design for combining the attribute levels can be found with help from different software packages, for instance SAS.

Full factorial design

A full factorial design combines every level of each attribute with every level of all other attributes (in Cochrane and Cox, 1957 according to Holding & Adamowicz, 2003, p. 179). In our example, a good is described with 3 attributes with respectively

2, 2 and 8 levels. A full factorial design gives 2*2*8 = 32 possible combinations of alternatives.

A full factorial design has many virtues. It is orthogonal, meaning that each of the variables has zero correlation with any one of the other variables. This implies that the influence of any of the attributes on the respondents' choices can be identified and measured and that all estimates are unbiased and statistically efficient. In a full factorial design, all main effects, and higher-order interactions, are estimable and uncorrelated (Kuhfeld, 2004). A main effect is a simple effect of an attribute without consideration of the levels of the other attributes. Let us consider the experiment in the present study, where utility of a product is explained by 3 attributes: food safety, animal welfare and price. The main effect of food safety is the marginal utility of food safety, regardless of the level of animal welfare and price levels. An interaction effect exists if the marginal utility of food safety depends on the level of animal welfare. For example, if the marginal utility of food safety is higher for a high level of animal welfare then the attributes are complementary attributes, whereas if the marginal utility of food safety is lower for higher levels of animal welfare they are substitute attributes (Holmes & Adamovicz, 2003, p. 182)[28].

Often, however, it is practically impossible to use the full factorial design. Having, for instance, 8 attributes with respectively 2, 2, 3, 3, 4, 4, 6, 6 levels, amounts to 20,736 possible alternatives. It is simply not possible to include them all in a survey.

Fractional factorial design

With a fractional factorial design it is possible to create a design with fewer alternatives, but at the cost that some information is lost and, therefore, some interaction effects are no longer estimable. In a fractional factorial design, the selections of combinations can be made in such a way that the most important effects can be estimated (typically the main effects and some cross effects). A difficulty in using a fractional factorial design is that interactions between attributes, for which inclusion in the analysis is desired, need to be anticipated in the design phase. This is due to the necessary to include a sufficient number of alternatives to make the effect estimable. If existing interactions are not anticipated and identified, then some effects may become confounded (aliased), which is when two effects are not distinguishable from each other (Kuhfeld 2004). Focus groups or other pre-analyses can be used to shed some

[28] In a model with interactions, brand preferences are different at different price levels and the price effects are different for different brands (Kuhfeld et al., 1994).

light on possible interaction effects (Holmes & Adamowicz, 2003, p. 182). Louviere (1988)[29] suggests that more than 80% of the respondents' behaviour can be explained by main effects. And, in most cases, the fractional factorial design ensures orthogonality (Kuhfeld 2004).

Unrealistic alternatives

Full, as well as fractional factorial, designs can result in implausible alternatives (Bateman et al. 2002) and this might cause problems in consumer surveys. It can be useful to exclude unrealistic alternatives from the full or the fractional factorial design, as unrealistic alternatives might increase the risk of non-serious answers. Let us refer to the present example of utility of a product with the attributes food safety, animal welfare and price. An unrealistic alternative that should be excluded could be one that combines the minimum price with maximum levels of food safety and animal welfare. The cost of eliminating alternatives from the design, however, is that the design is no longer orthogonal (Bateman et al., 2002, p. 264) and, thereby, unavoidable correlation between the parameter estimates is introduced (Kuhfeld 2004).

3.5.4. From alternatives to choice sets

Number of choice sets and number of alternatives in a choice set

First, the issue of choosing the optimal number of choice sets and the optimal number of alternatives in each choice set is discussed. There are no stringent optimality criteria to solve this problem, but some guidelines are available.

Once an experimental design has been chosen, the next step is to package the alternatives and present them to the respondents (Bateman et al. 2002, p. 265). If a full factorial design is chosen, often there will be too many alternatives to deliver a manageable task for each respondent. One extreme is to present each respondent with all alternatives in a single choice set and let each respondent make only one choice. In our example with food safety, animal welfare and price, there are 32 alternatives – and we would let each respondent pick just one out of these 32 alternatives. The other extreme is to include only 2 alternatives in each set and let each respondent make several binary choices. In the above example, each respondent would be asked to choose the most preferred alternative 16 times (32 alternatives would be combined into 16 choice sets). The first solution would require enormous cognitive burden to assess 32 alternatives in one choice task, whereas in the second solution, the individual choices

[29] According to Bateman et al., 2002, p. 264.

would be simpler, but there would be a risk of fatigue (or learning) effects during the process of choosing 16 times.

The options are either to reduce the number of attributes and/or levels offered, or to group the attributes into subsets and construct a smaller design for each set. A third solution is to split the full number of choice sets into blocks and offer each respondent only one block. Thereby, only a few alternatives need to be included in each choice set. The two latter solutions require larger sample sizes, for instance if a statistical significant estimate requires 500 respondents, then splitting the design into three blocks requires 1,500 respondents (Bateman et al. 2002 p. 267).

What is the optimal combination of number of alternatives in a choice set and number of choice sets to present to each respondent? There is no straightforward answer, merely some guidelines. More familiar subjects may allow more choice tasks per respondent and more complex subjects constrain the number of choice sets to the respondent. If a choice set involves only few attributes and attribute levels, the respondent is able to manage more choice sets. For a discussion of the optimal complexity of choice experiment, see Caussade *et* al. (2005). Here, the authors describe the complexity of an experiment by five design dimensions: number of available alternatives, number of attributes used to characterise the alternatives, number of choice situations presented to the respondent, number of attribute levels and the variation range for those levels. The design dimensions are varied in a systematic fashion, according to a first experimental design hierarchy. They conclude that all five design dimensions affect the choice consistency. However, they do not find systematic effects on willingness to pay estimates.

For further discussion of choice set design, see Ryan & Wordsworth (2000), Hensher et al.(1999), Blamey *et al*. (2001), Carlsson & Martinsson (2003), Carson et al. (1994), Kuhfeld (2004), Batsell & Louviere (1991), Anderson & Wiley (1992) and Huber & Zwerina (1996).

Criteria for optimal designs

For real-life experiments involving human objects, an optimal design is a trade-off between statistical efficiency, cognitive ability and survey budgets. In order to make these trade-offs operational, 4 criteria (level balance, orthogonality, minimal overlap and utility balance) are used to generate optimal utility-neutral choice designs (Huber & Zwerina 1996). In practice, it is not possible to satisfy all criteria and several definitions of efficiency have been developed that include the above criteria in different

ways. Below, the criteria and the different types of efficiency measures are discussed briefly and arguments are presented for the choice of design in the current analysis.

Level balance
A design is balanced when each attribute level occurs equally often within each attribute. This implies that the intercept is orthogonal to each effect. The level balance criterion requires that the levels of each attribute occur with equal frequency in the design. So, if an attribute has three levels, each level has to appear in 1/3 of the alternatives (Huber & Zwerina 1996).

For studies involving human subjects, achieving at least nearly balanced design is an important consideration. If one level occurs more than other levels, respondents may try to read something into the study and adjust their response in some way. Alternatively, respondents who see one level more often may respond differently than those who see another level more often. One design strategy is to choose the most balanced design from the top five efficiency scored designs.

Orthogonality
When every pair of levels occurs equally, often across all pairs of attributes, the design is said to be orthogonal or, put another way, a design is orthogonal when the joint occurrence of any two levels of different attributes appears in profiles with frequencies equal to the product of their marginal frequencies (Addelman, 1962). This version of orthogonality implies level balance. Another way in which a design can be orthogonal is when the frequencies for level pairs are proportional instead of equal, but such a design will not be balanced, one level can occur twice as often as the other (Kuhfeld 2004).

When a linear model with normal error terms is fitted with an orthogonal design, the parameter estimates are uncorrelated, which means each estimate is independent of the other terms in the model. Furthermore, orthogonality usually implies that the coefficients will have minimum variance – though there are exceptions to this rule (Kuhfeldt et al. 1994). In field trials in natural science experiments, orthogonal design is the standard design criteria. Orthogonal designs are often practical for main effects models when the number of attributes is small and the number of levels of each attribute is small. However there are some situations in which orthogonal designs are not practical, such as when:

- not all combinations of factor levels are feasible or make sense
- alternative specific factors are present

- interactions within each alternative are present
- the desired number of runs is not available for an orthogonal design
- a non-standard model is being used, such as a model with interactions or polynomials (Kuhfeld, 2004)[30].

In a linear design, an optimal design must fulfil two criteria to be D-efficient: level balance and orthogonality (Carlsson & Martinsson 2003). If the model used is non-linear instead of linear, also criteria of minimal overlap and utility balance have to be fulfilled to secure D-efficiency (Huber & Zwerina, 1996).

Minimal overlap
If the attribute levels for an attribute are held constant in a choice set, then no statistical information about this attribute is obtained. Maximum information for a choice set is obtained by ensuring no overlap. That is, minimal overlap in attribute levels in pairwise comparisons.

Utility balance
The utility that individuals derive from an alternative is considered to be associated with the levels of the attributes of the alternative (Carlsson and Martinsson 2003). Utility balance requires that the utility of each of the alternatives in a choice set is equal to any other. This criterion ensures that the respondents are forced to make marginal trade-offs and, thereby, allows maximal information about the preference structure to be extracted from the choice task.

Design

Orthogonal and D-optimal design
Traditionally, orthogonal designs where the levels of each attribute vary independently have been preferred in experiments. The main reason for this is likely to be that the parameter estimates of a linear model are uncorrelated when using an orthogonal design (Carlsson & Martinsson, 2003).

A choice experiment should avoid dominant or inferior attributes and it is important that the alternatives are credible. Orthogonal designs disregard this aspect of design and only ensure that the effects of the different attributes can be estimated independently of each other. A D-optimal design explicitly considers the importance of the levels of the attributes and ensures that the alternatives in the choice sets provide

[30] Kuhfeld use the %MktEx macro to find the good efficient experimental design.

more information about the trade-off between the different attributes. The D-optimal design, however, still relies on prior information on the distribution of the parameters. The D-optimal design is very sensitive to biased information from pilot studies, but also the orthogonal design needs prior information of the attributes in order to select attribute levels in a way that no attribute becomes either superior or inferior to the other (Carlsson & Martinsson, 2003).

A common measure of efficiency, which relates to the covariance matrix, is D-efficiency. Several other efficiency measures can be used (A-, G-efficiency), but D-efficiency is the less computationally burdensome. The D-optimal design is created with the software package SAS, using the search algorithm presented in Kuhfeld (2004)[31].

Cyclical design

A cyclical design is a simple expansion of the orthogonal design, but it can only be used in the case of a generic model, i.e. where the parameters of the attributes have the same impact on utility, independent of the alternative (which is the case in the present analysis) (Carlsson & Martinsson 2003). The procedure is first to allocate each of the alternatives from a full/fractional factorial design to different choice sets. Attributes of the additional alternatives are then constructed by cyclically adding alternatives into the choice set, based on the attribute levels. The attribute level in the new alternative is the next higher attribute level to the one applied in the previous alternative. If the highest level is attained, the next attribute level is set to its lowest level (Bunch et al., 1996). The cyclically generated alternatives are favourable because they represent the perfect level balance and orthogonality, and the symmetry of the design causes minimal overlap (Huber & Zwerina 1996). However, utility balance is not secured.

Comparing designs

Carlsson and Martinsson (2003) compare different design approaches for stated preference surveys. They concentrate on the orthogonal design and D-optimal design, with and without prior information of the parameters. Using simulations, they find that the choice of design technique affects the precision in the estimates. They strongly recommend researchers to use the D-optimal design with prior information of the parameters as it performed much better than the other design approaches. How-

[31] The code can be downloaded at: /**ftp://ftp.sas.com/techsup/download/technote/ts643/** See Carlsson & Martinsson (2003) p. 293.

ever, this is not surprising as knowledge concerning the true parameters is used, thereby yielding better estimates of marginal WTP. If prior information is not used, however, then the cyclical design is preferred over both the orthogonal design and the D-optimal design.

3.5.5. Opt-out

An important feature in the design of a CE is whether the respondent should be given the opportunity of not choosing one of the presented alternatives in the choice sets (that is, to *opt-out* of the experiment). A major argument in favour of including an opt-out alternative in the choice set is that if the choice situation reflects a real-life situation where it is possible to opt-out, then it is necessary to include an opt-out in order to interpret the results within a welfare economic framework. If such an opt-out alternative is not included in the choice sets, respondents are being forced to choose an alternative which they may not desire at all. This could lead to overestimation of the probability of choosing one of the alternatives (Boyle et al. 2001) and, in turn, will lead to inaccurate estimates of consumer welfare. As a result, a *status quo* alternative or an opt-out option is usually included in each choice set (Bateman et al. 2002; Kontoleon & Yabe 2003).

Moreover, an opt-out option might reduce the problem of protest answers. Typically, protest answers are identified through follow-up questions and deleted from the data, see, for example, Bennett & Adamowicz (2001) and Ryan & Wordsworth (2000) (for further insight with regard to protest answers, see Chapter 4).

However, at times it is rather complicated to include these options in the design in a meaningful way, and to include them in the estimation procedures. Therefore, a considerable number of studies discuss the opt-out alternative. In some situations, an obvious opt-out choice is the *status quo* situation (environmental policy issues often include a *status quo*). When valuing consumer's buying behaviour, the *status quo* is sometimes interpreted as a similar good that is usually purchased; see, for example, Burton et al. (2004), Mazzanti (2003), and Haaijer et al. (2001). Another way around the opt-out problem is found in Carlsson et al. (2004b). The authors, here, do not include the opt-out alternative, but instruct the respondents only to answer the CE if they actually consume the good.

For further discussion of the opt-out alternative, see Ryan & Skåtum (2004), Ruby et al. (1998), DeShazo et al.(2004), Adamowicz et al. (1997) and Banzhaf et al. (2001) and Appendices D and E.

3.5.6. Cheap talk

Cheap talk is used to describe some information to the respondents in which they are reminded about the fact that individuals often act differently towards a hypothetical scenario in a questionnaire than they would in a real situation where they were faced with the same problem. Such a reminder is found to reduce the risk that respondents state a higher willingness to pay than they would in a real situation, due to some kind of moral satisfaction (*warm glow*). Carlsson et al. (2004c) evaluate the use of cheap talk. In two experiments on the choice of consumer goods, the estimated marginal willingness to pay for food was found to be lower in the survey version where cheap talk was included. Hence, Carlsson et al. (2004c) conclude that the hypothesis of a hypothetical bias for marginal willingness to pay in choice experiments cannot be rejected. See also Carson et al. (2001) and Cummings & Taylor (1999).

4. Data

The data was collected through a questionnaire survey in January and February 2005. A detailed description of how the questionnaire is designed is found in Section 4.1, followed by a description of the actual questionnaire in Section 4.2. An overall description of the data is given in Section 4.3. Section 4.4 contains descriptive statistics (and checks for representativity) with respect to socio-demographic variables and, finally, Section 4.5 focuses on describing data with respect to attitudes. Relevant graphs and tables are provided in Appendix C.

4.1. Designing the questionnaire

The questionnaire is designed to produce data for improving the understanding of consumer risk perception and food choice in relation to food-related health risks – and how these are influenced by expert information. More specifically, the objectives are restated here as to:

- Estimate the willingness to pay for outdoor production systems (animal welfare) and avoiding campylobacter risks (food safety)
- Focus particularly on how information containing *expert advice* based on scientific risk assessment influences risk perception
- Identify the possible *societal value* (welfare gain) of providing information to consumers by means of e.g. public campaigns or labelling
- Identify how risk perception and the effect of information changes across *consumer types*.

The questionnaire consists of a choice experiment and questions concerning background information. Basically, the choice experiment is used to elicit estimates of the average willingness to pay for the attributes *and* the average effect of information. The background information is used for consistency checks, to elicit risk perception and to elicit the respondents' prior information levels, thereby, determining the "news" value of the information that is provided in the questionnaire.

Designing an experiment involves choosing how many attributes and attributes levels to include and how to describe them, as well as choosing the number of choice sets that each respondent is given and the number of alternatives in each choice set.

The following were considered important in design of the analysis:

- Limiting the complexity of the experimental design as much as possible.

- Employing a full factorial design, the main reason being that there was very little prior knowledge of potential cross effects. Therefore, a fractional factorial design that included the relevant cross effects was not an option.
- Extraction of a limited amount of information with many repetitions rather than much information from fewer respondents[32]; the reason being that few, but statistically significant, results were desired rather than many, but insignificant, results.
- Scientific documentation of the information provided by the analysis and realistic attribute levels.

The most important considerations regarding designing the present choice experiment are described below in relation to the above-mentioned criteria – from choosing a product, attributes and their level to choosing the experimental design and the final statistical design. Finally, the design used in this survey is presented.

4.1.1. Choice of product and attributes

The choice of product is evidently important due to the hypothetical nature of the experiment. Furthermore, the product can be described through a number of attributes/characteristics which are presented to the respondents in order to value the good/product in question.

Attributes

Risk is a difficult characteristic to assess. Hence, we have chosen only three attributes to achieve our objective[33]. There are many different kinds of food-related risk. Further risk can be formulated in terms of the risk suffering an infection or a mortality risk. The risks include undesirable effects of pesticide application such as pesticide residues in food products, undesirable effects of GMO application, undesirable risk from medicine usage and microbiological risks such as BSE, campylobacter and salmonella. In general, risk expressions can be hard to understand (Jensen et al. 2004). Therefore, a great effort was made to formulate a food-related health risk that was easy to describe and to provide information about (Bennett & Adamowicz 2001).

[32] This decision led to the choice of an Internet-based survey where the time it takes to fill out the survey should not exceed 15 minutes as compared to a postal or personal interview survey where the survey is not limited in the same way. The advantage of the Internet-based survey is that it is not as expensive, so a larger number of respondents can be included. Also, the time dimension is an advantage of the Internet-based survey, as the results can be in a database within 14 days.

[33] Normally, the number of attributes is restricted to a relatively small number such as 4, 5 or 6.

Common knowledge in the population about campylobacter is smaller than that on BSE, GMO and salmonella (Jensen et al. 2004). Most people have knowledge about salmonella through the media and public campaigns, which creates an attitude towards salmonella that can be hard to change (Lassen 2004). Also, BSE has received massive coverage in the media. The hypothesis, here, is that information on salmonella or BSE would not produce any changes. Furthermore, BSE is a complex issue to explain and provide information on. GMO application is a controversial item and the scientific documentation for whether GMO constitutes a risk or not for the human health is not yet clear. For that reason GMO products were not selected for the present analysis.

Salmonella exists in all forms of eggs and in chicken meat, whether produced as free-range, organic or conventional. Eggs are an attractive product as far valuing attributes is concerned, because there is little difference in eating quality between the different types of eggs. However, there is no clear link to the production method and the scientific documentation for the biological relation is uncertain. For that reason, and because of the expected beforehand attitude towards salmonella, salmonella was rejected as the food-related health risk.

There are no campylobacter in eggs – but there are in chicken meat. There is scientific evidence that all outdoor free-range chickens contain campylobacter, whereas only one third of the chickens raised indoors have campylobacter[34]. Hence, choosing between chickens raised outdoors versus indoors involves a real choice with regard to campylobacter content. As a result, campylobacter risk was selected as the food safety attribute. In choosing campylobacter, an effect of information on consumer behaviour was hoped to be revealed.

Furthermore, animal welfare is included as an attribute. Animal welfare is a pure public good, whereas food safety can be assigned as a semi-public good. By including both types of good, the way in which respondents value and make trade-offs between pure public and other goods can be examined. Furthermore, animal welfare is expected to be an attribute where people have pre-determined attitudes, just as with, for instance, GMO. In this way, the opportunity presents itself for testing the influence of information about an unknown attribute (campylobacter) and a known attribute (animal welfare).

[34] Source. Homepages of Ministry of Food, Agriculture, and Fisheries 2002 www.fvm.dk and The Danish Poultry Council 2004 www.danskfjerkrae.dk

Product

It is easier for a respondent to decide on a product described in terms of attributes, than to express preferences on the attributes themselves (Burton et al. 2004). In choosing which product to link the attributes to, it is important that the respondents know and buy the product. This can reduce the opt-out percentage (Bennett & Adamowicz 2001). Chicken meat is, therefore, considered to be a good with which almost everyone is familiar with and uses in their everyday life.

More specifically, we have chosen a 1,300 gramme chilled chicken as product, although chicken breast fillets are more commonly used in everyday cooking (budget shares: 17% whole chilled chicken, 13% whole frozen, 41% chilled processed and 29% frozen processed chicken (GFK 2001)). Our argument is that a whole chicken is sold campylobacter-free, whereas breast fillets are not. In our follow-up questions, respondents are given an opportunity to express whether they usually buy breast fillets, whole chickens or whether they do not buy chicken meat at all. Thereby, the size of the problem can be identified and respondents who do not usually buy the product, and thereby could create bias in the responses, could potentially be removed from the sample (Bennett & Adamowicz 2001).

Attribute levels

Two attribute levels have been chosen for animal welfare and campylobacter risk, respectively, and eight levels for price. These levels are divisible by two, which makes it easier to construct a design ensuring orthogonality (Kuhfeld 2004).

The description of the attributes and attributes levels is provided by experts from the relevant scientific disciplines. As an indicator of animal welfare, two different breeding methods are used – one where chickens have outdoor access and the other where chickens are kept indoors at all times (in the questionnaire they are referred to as outdoor versus indoor breeding[35]). These levels are easy to explain, both in the text with/without information and in the attribute presentation itself. It is the general scientific opinion that chickens raised outdoors with more space, etc. are better off than chickens raised in conventional breeding systems. However, there are unfortunate side effects such as more peeling and higher mortality in organic production. Therefore, the link between breeding method and animal welfare is not quite clear. The

[35] The description of outdoor breeding is similar to the requirements in organic production systems with respect to outdoor access, space, life time, dust bathing (for a full description, see Appendix A). However, the term organic is not mentioned in the survey in order to avoid confusion of whether the respondent interpret other organic elements into the animal welfare attribute.

problem was dealt with by not including these side effects of organic farming. Furthermore, animal welfare is not mentioned in the choice experiments in order to allow respondents to create their own links between breeding methods and animal welfare. These choices of information provision might result in a too positive description of outdoor breeding.

For the campylobacter attribute, the levels and the way in which the attribute should be described were more difficult. The levels of the attributes should vary across intervals that are realistic and over which we expect respondents to have preferences (Ryan & Wordsworth 2000; Bennett & Adamowicz 2001). From the use of focus groups and pre-tests, it was decided to express the campylobacter attribute either as being labelled campylobacter-free or having no label. A more specific labelling could be the difference between organically produced chicken and conventionally produced chicken. However, organic labels have a strong position in consumers' minds. Hence, such labels can prompt respondents to select their preferred alternative on the basis of the label alone (Bennett & Adamowicz 2001).

The attribute levels are formulated in a slightly skewed manner. The campylobacter attribute is formulated as a label whereas the animal welfare attribute is formulated as a description. The intention of this was not to identify the difference between calling information a label and a description/declaration of the good, but was a result of a desire to mimic, as far as possible, a real shopping situation. In Denmark, there is a campylobacter-free label, whereas production information is provided as information on the package. Some might argue, that it can bias the results that one attribute is a label and the other not – however, the assumption is that it makes no difference as far as the respondents are concerned.

Description of the attribute levels as "with campylobacter" or "campylobacter-free" was considered. However, this wording has at least two drawbacks: 1) By using the description "with campylobacter", too great a focus is placed on this attribute compared with the real-life situation, where this label does not exist. 2) It is not true that every chicken not labelled "campylobacter-free" contains campylobacter, so it would be directly misleading to label a chicken "with campylobacter" 3) Realism is lost in the choice experiment with the wording "with campylobacter" because it is not possible for the consumer to go to a supermarket and buy a chicken labelled "with campylobacter". Instead the risk levels was described in the terms of "campylobacter-free" and "not controlled for campylobacter".

The price levels were determined based on the pre-test, as recommended by Bennett & Adamowicz (2001) and Bateman et al. (2002). The pre-test comprised asking 30 friends and 150 students about their maximum willingness to pay for a 1,300 gramme chilled chicken, free of campylobacter and produced as outdoor free-range. A payment card was used, where the respondents were asked to select their maximum willingness to pay. The payment card contained twelve different prices in a range from DKK 40 to DKK 280. The range where created exponentially as recommended by Rowe et al. (1996). From the pre-test, a maximum willingness to pay of 110 DKK was detected and, therefore, used as the upper level in the experiment. An exponential response scale has the advantage that the intervals between any two values increase at an increasing rate, thereby avoiding identical intervals (Ryan & Wordsworth 2000). If the interval between the levels is identical, say 20 DKK, there is a risk that respondents make trade-offs based on the interval (at 20 DKK) and not the price, itself, and potentially create a bias. In the choice experiment, however, it was decided not to use the exponential scale as this scale may have resulted in too many low values and only few high values with very large differences in interval between the values. Instead, the price levels were modified, still keeping the differences in intervals and the detected maximum willingness to pay.

Dominant alternatives

Before it can be identified whether one alternative dominates in a choice set, the attribute levels need to be ranked.

With respect to price, it can be assumed with confidence that decreasing utility is associated with increasing levels of the price attribute. This is equivalent to an assumption that, where the other attributes are held constant, the consumers would prefer a lower price of a chilled whole chicken to a higher price (i.e. a chicken is a *normal* good).

Similarly, with respect to campylobacter, it was assumed with confidence that ranking the attribute levels such that all else being held constant, consumers would prefer to avoid campylobacter.

With respect to animal welfare, the same degree of confidence in ranking the attributes was not apparent. The expectation is that most people will find that animal welfare associated with outdoor production methods is clearly better than with indoor mehtods, while others will find the differences so small that they are not worth con-

sidering[36]. Others again may find that indoor production systems are, in fact, better than outdoor production systems. In the final ranking, the production systems were ranked such that outdoor production is better than indoor production.

4.1.2. Information provision and attribute description

How can the attributes be described without providing information about them? The "basic" information provided includes whether the chicken has been bred inside a barn or outdoor in the field (animal welfare attribute), but not what consequences this has for the chickens' welfare. The expert information describes differences in the breeding methods including information about the difference in space (m^2 pr. chicken), circadian rhythm, natural behaviour patterns (e.g. dust bathing) and length of life. Expert information about food safety (campylobacter risk) is twofold. It includes typical as well as rarer symptoms, the general risk of campylobacter infection and a short instruction on how to prevent a campylobacter infection with good kitchen hygiene.

4.1.3. The design

Three attributes (animal welfare, campylobacter content and price) with 2, 2 and 8 levels, respectively, provide a full factorial design of $2^1*2^1*8^1 = 32$ possible alternatives.

A respondent choosing a dominant alternative does not provide any information on trade-offs between attributes. Nevertheless, it might be better still to keep the dominant alternatives than to exclude them. Firstly, this makes us able to test for consistency. The second reason is that eliminating dominant alternative would give a less efficient design.

Before designing the choice sets, the two extreme alternatives respectively as these were bound to dominate, i.e the alternative with the lowest price and the highest levels of food safety and animal welfare, and the alternative with the highest price and the lowest levels of food safety and animal welfare.

[36] Finding from focus groups.

A full factorial design[37] involves only 16 choice sets. Initially, a cyclical procedure was used to pair the alternatives into choice sets, but, after reviewing the design, it was found that the design contained too many dominant alternatives. Instead, a D-optimal full factorial design was finally selected, with 16 choice sets containing 2 alternatives (an opt-out alternative was then added to each choice set). Dominant alternatives were also apparent in the D-optimal design. Instead of removing the remaining dominant alternatives, however, the levels of the animal welfare attribute and the food safety attribute were swapped (Huber & Zwerina 1996), producing just 3 dominant alternatives in 16 choice sets. These dominant alternatives were then used for a consistency test, so each respondent received one or two choice sets with a dominant alternative during the 8 choice tasks.

As the questionnaire is relatively time-consuming, each respondent was only offered 4 choice sets without information and 4 choice sets with information. This was achieved by dividing our design into 4 blocks (A,B,C,D) with 4 choice sets in each. No respondent received exactly the same block, with and without information. This was ensured in order to reduce the risk of respondents simply repeating their choices from before the information was provided.

4.2. Structure of the questionnaire

Below the structure of the questionnaire is described and explained. The structure of the questionnaire can be roughly divided into 5 parts –

1) Introduction
2) Choice experiment without information,
3) Attitudinal questions regarding foods in general
4) Choice experiment with information (2 splits) and,
5) Attitudinal questions regarding foods and socio-demographic variables.

The entire questionnaire is found in Appendix A, and the Q-numbers below refer to the question number in the questionnaire.

[37] The full factorial design still consists of 32 alternatives as the above-mentioned 2 alternatives are replaced by two alternatives that are used twice.

Re 1. Introduction

General introduction
The questionnaire begins with a short introduction to the survey and the overall purpose of the project in order to inform the respondents and gain their confidence. Furthermore, the introduction contains a paragraph where the respondents are reminded of their budget constraint and that they should act as they would in an everyday shopping situation, to help ensure the respondents answer as honestly and realistically as possible.

Introduction to choice sets without information
The respondents are introduced to the different attributes connected to chilled chicken and the different attribute levels. To ensure that the respondents only focus on these two attributes and the price attribute, a statement was included to the effect that all other thinkable attributes connected to chilled chicken are alike, e.g. taste, freshness, shelf-life and nutrient content.

Re 2. Choice sets without information Q1.
The first 4 choice sets do not provide the respondent with any further information regarding animal welfare attribute or campylobacter – only that the choice is between outdoor-bred or indoor-bred chicken and a label stating the product is campylobacter-free or no label.

Re 3. Attitudinal questions regarding foods in general

Q. 2 - 4: Difficulty in the choice sets
The questions concerning how certain the respondents were in their choices provide us with the opportunity to exclude some of the respondents if they were too insecure in making their choices. Such questions have, in previous studies, been found to be very useful and to increase the efficiency of the estimates.

Q. 3 Opt-out reasons
In the choice set, as little focus as possible was placed on the opt-out alternative in order to limit the frequency of opt-out choices (hvad menes med det? At det er skrevet med småt eller ikke på forhånd beskrevet….?). However, if the respondents opt-out then it is very important to know why they opt-out. Therefore, a range of questions was included for the respondents choosing the opt-out alternative. The first reason is that it is important to identify potential protest bidders. If the respondents have

selected, as their reason for choosing the opt-out alternative, that they support animal welfare (Option 10) or campylobacter-free chickens (Option 11), but do not think that it is the consumer who should pay for this, they are recognized as protest bidder. This is because they gain utility from higher levels of animal welfare and lower levels of campylobacter-risk, but are not willing to pay anything for obtaining that gain (Mitchell & Carson 1989).

Q. 5: The importance of the attribute
The respondents are asked to identify which characteristic among animal welfare, health and price, they find most important. This is carried out to validate the consistency between the respondents' stated preferences (answers to Q5) and their observed behaviour (choices in the experiment). That is, if respondents find e.g. animal welfare to be the most important attribute, they have to value it highest in the choice sets. The argument for constraining the respondent to choose only one of the characteristics is because it would be very difficult to check for inconsistency if more than one characteristic was ticked.

Q. 6: Attitude towards food in general
The main purpose of this question is to give an overall ranking of various attributes associated with food in general – including production system, campylobacter risk and price. Moreover, the questions regarding production system, campylobacter risk and price will give us yet another test for inconsistency. The question whether it is important or not that the product is produced organically, is based on a hypothesis that consumers that buy organic food constitute a homogenous group of consumers with regard to their attitudes towards food safety and animal welfare.

Q. 7 & 8: Knowledge about kitchen hygiene
These two questions concern the respondents' present knowledge about kitchen hygiene – whether it can have an influence on the campylobacter risk or not and whether they consider their own kitchen hygiene to be good or poor. Thereby, the respondents' prior knowledge with regard to the attributes can be identified, in relation to the answers they gave for the 4 choice sets without information.

Re 4. Choice experiment with information

Q. 9: Introduction to the choice sets with information
The "introduction to the choice sets with information" contains the same introductory information as the introduction to the choice sets without information – that is, budget

constraint, cheap talk, etc. There are 4 new choice sets. The attributes are described precisely as the choice sets without information – the only difference is in the introductory text before the choice task begins.

One half of the questionnaires contain only expert information regarding the animal welfare attribute, and the other half of the questionnaires contain only expert information regarding the campylobacter risk. Thereby, the value of the information to the respondents' can be identified as the difference in willingness to pay due to the different information levels: 1) No information, 2) Expert information on animal welfare and 3) Expert information on campylobacter. Inclusion of a sample that received information about both attributes would have been desirable in order to test additivity of information, but this was not possible within the budget of the survey.

Choice set 5-8 with information
With these choice sets, the data basis was obtained for estimating the consumers' marginal willingness to pay for the attributes when information is included. Tests can identify whether attributes without or with information are different attributes or whether they are perceived as identical. If an information effect is apparent, then the attributes are perceived as different, whereas if information has no effect then the attributes are considered identical.

Re 5. Attitudinal questions and socio-demographics

Q. 10-13: Difficulty, certainty in the choice sets and the importance of the attributes: animal welfare, health and price
Follow-up questions regarding certainty in the choice experiment and questions regarding the importance of the attributes: animal welfare, health and price. The reason for including the questions regarding the importance of the attributes again, is to check whether inconsistency changes after information has been provided.

Q. 14: The coherence between outdoor reared chickens and animal welfare and campylobacter, respectively
The two questions regarding people's knowledge about the causal connection between breeding methods and animal welfare and campylobacter-risk provide, besides a consistency check, an explanation of the choices the respondents have made in the choice sets. For instance, if they do not think that outdoor-bred chickens have higher welfare than indoor-bred chickens, then they might not have a higher willingness to pay for the animal welfare attribute. The same can be argued in the case of people's

opinion and knowledge about the campylobacter-risk in outdoor *versus* indoor-bred chickens. Furthermore, it is very important to identify whether or not the respondents know the causal connection which really exists between breeding method, animal welfare and campylobacter-risk. If they are aware of this causal connection, then the respondents may think that some of the different alternatives are too unrealistic because they break with the existing causal connection. This may lead them not to answer the choice sets or to answer in a biased manner.

Q. 15: Attitude towards food safety, environment and animal welfare
The questions regarding the respondents' attitude towards health and animal welfare can be divided into two categories – those which check for consistency and those used for answering hypotheses.

a. I think there is too much hysteria surrounding the animal welfare issue
b. I support animal welfare through my choice in food products
c. I think that outdoor reared chickens taste better than indoor reared chickens
d. Although infection by campylobacter can be prevented through maintaining good hygiene basics and correct food preparation practices, I do not want to have campylobacter bacteria in my kitchen
e. I think there is too much hysteria surrounding the campylobacter issue
f. I believe that the producers are responsible for supplying food products that carry no health risks for the consumers.
g. If the authorities could ensure reliable labelling, I would be happy to pay extra for campylobacter-free chicken
h. If the authorities could ensure reliable labelling, I would be happy to pay extra for increased animal welfare
i. I believe that the authorities are responsible for carrying the costs of ensuring campylobacter-free chicken meat.
j. I believe that the authorities are responsible for carrying the costs of increased animal welfare
k. I believe that eating Danish food products carries no health risks

The questions *a* and *h* (*e* and *g*) can be used for checking for consistency for the animal welfare attribute and the health attribute (campylobacter-risk), respectively. In example, if the respondents agree on question a they should have a lower willingness to pay for avoiding campylobacter-risk.

Questions *f, i* and *j* are used as checks for protest bits – these questions may be crossed-checked with question 3 (10) and 3(11), as mentioned before.

Q. 16: Attitude towards information on foods
One of the main purposes in the survey is to test whether expert information has an effect on consumer behaviour. Consequently, the respondent is asked how much they trust "our" source of expert information. This is very important in the context of risk perception. The questions are not used directly in the interpretation of the choice sets, however, besides testing whether or not the respondents trust the expert statements in the questionnaire.

Q. 17-19: Beforehand knowledge
These questions on prior knowledge to campylobacter and salmonella give us some knowledge about the respondents' former knowledge and experience with the campylobacter bacteria. If a respondent is familiar with campylobacter, she might not react so strongly to the expert information and the willingness to pay for reducing the campylobacter risk might be lower than another respondent's willingness to pay.

The questions on prior knowledge of salmonella might show that people who are familiar with salmonella transpose this acquaintance to campylobacter and, therefore, have a higher willingness to pay for reducing the campylobacter risk.

Q. 20-21: Health
This question regarding the respondents' health provides information for the hypothesis concerning the extent to which people who think their health is good may consider the real campylobacter-risk to be lower for them, then the campylobacter-risk which is stated in the choice sets.

Q. 22-23: The respondent's usual consumer behaviour.
These questions are put in to identify the kind of chicken product the consumer usually buys. In the estimation procedure, the information is used to model the opt-out scenario for each respondent.

Q. 24: Membership
If the respondent has been a member of an organisation to improve animal welfare, this should explain a higher willingness to pay for the animal welfare attribute. This is not a hypothesis, because the variable "membership" is inextricably linked with the

animal welfare attribute. That is why the questions regarding membership are "only" used as a consistency check for the willingness to pay for animal welfare.

Socio-economic questions
Finally the socio-economic characteristics are identified. This is not carried out through the questionnaire, itself, because these exist as background knowledge from the internet panel from ACNielsen. The two primary purposes for including the selected characteristics of the respondents are to 1) check the representativeness of the respondents and 2) to be able to perform sub-group analyses.

It is expected that the respondents are representative because the survey is conducted with an ACNielsen online panel, which has already been selected to be representative. The sub-group analyses are performed to identify whether or not a difference exists between socio-demographic groups.

4.3. Data

4.3.1. Description of ACNielsen's database

Our data is based on a survey. Ideally, a survey would include the entire population such that everybody's opinion is heard. This is typically not practical and a representative sample is heard instead. Samples can be representative with respect to different key factors (age, income, geography, political opinion, etc.) and the choice of key variables depends on the purpose of the analysis. In general, the larger the sample, the better the picture of the true population which can be obtained. There is a trade-off between choosing a sample that is representative with respect to many key variables and having a large number of respondents in each sub-group.

The data collection procedure in this survey was conducted by ACNielsen, through their Internet panel. In the present section, the Internet panel of ACNielsen is described, including how the panel is composed in relation to WebDenmark and the Danish population as a whole. In relation to this, the random sample from our survey is described, ie. who received the questionnaire, who responded and who was screened out due to protest bidding and inconsistent answers. The final sample of respondents, which forms the basis for the further estimation in this survey, is described by comparing the sample with the composition of the Danish population as a whole.

The data's composition of gender, age, personal income etc. is tested in relation to data from Statistics Denmark. The representativity estimates are based on *chi*-tests.

The sample was obtained from ACNielsen's online database of approximately 25,000. In Denmark, there are approximately 2.4 million private households, of whom 75% are "online". The panel members are all in the age 15 to 99 years' old, resident in a household with PC and they all have a private internet access. The distribution between the genders in the online panel is 52% women and 48% men.

The online panel is representative with respect to the 75% of the Danish population that has internet access in their homes. We face a potential bias here: our goal is the estimate of consumer behaviour that is representative for Denmark as a whole, but the online panel only represents 75% of the population.

For the present survey, a sample of the online panel was used rather than the entire web panel in the database. This could either improve or reduce the representativeness of our sample when measured against the distribution of the Danish population. The respondents in our survey were drawn from the online panel through a quota selection system. The quotas were created on the basis of gender and age, with the aim that the sample mirrors the distribution of gender and age apparent in the Danish population.

The above-mentioned uncertainty is statistical uncertainty, related to how the sample is drawn. A survey is subject to a whole range of potential sources of uncertainty. There is uncertainty with respect to the quality of the answers, non-responses (biases due to respondents not answering the whole questionnaire) and statistical uncertainty. The effect and the extent to which statistical uncertainty influences our results will be clarified during the descriptive statistics below.

4.3.2. Description of data

8,008 individuals were invited to fill out the questionnaire, of whom 4,685 respondents answered. This gives a response rate of 58.5 %. From the 4,685 answers, 581 were incomplete. These answers were removed by ACNielsen and a dataset containing 4,104 respondents was received, corresponding to a response rate of 51.2 %. The general response rate of ACNielsen's online panel lies in the range of 50 %.
More specifically, protest answers (246 respondents) relate to the following reason for choosing the opt-out alternative: the respondent supports animal welfare (Q3, Option 10) or campylobacter-free chickens (Q3, Option 11), but does not think that it is the

consumer who should pay for these attributes. This is recognised as protest answers because utility is gained from higher levels of animal welfare and lower levels of campylobacter-risk, but there is no willingness to pay for obtaining the gain

Dominated answers were found for 121 respondents[38]. If a respondent chooses a dominated alternative in at least one out of the 8 choice sets, then the respondent is excluded. This corresponds to 3 %. Hence, these respondents failed our rationality test and are disregarded in the further analysis[39].

Moreover, respondents who answered that they usually purchase chicken for less than DKK 40 (650 respondents) or more then DKK 110 (14 respondents) were removed because their individual opt-out alternative cannot be included if the price is not within the same price-range as the other alternatives. Furthermore, 772 respondents answered that they could not remember their usual purchases. They are excluded from the analysis, again, because we cannot model their individual opt-out alternative, but, more importantly, because they are potentially unserious respondents. In the estimation process, the results are revealed not to be particularly sensitive to elimination of these respondents (for a further discussion see the estimation chapter, Chapter 5).

Hence, the dataset consists of **2,301** respondents for use in the further analyses. The descriptive statistics only include the respondents presented in the analysis – that is 2,301 individuals – as these form the basis on which the following estimates are derived and interpreted. Half of the questionnaires contained information regarding campylobacter (1,180 respondents) and the other half contained information regarding breeding method (1,121 respondents).

The dataset can be divided into 2 datasets: Sample A is the dataset retrieved from respondents given campylobacter information and Sample B is the dataset retrieved from respondents given breeding method information. These are further divided into 2 datasets according to choices made before and after information is provided: choices

[38] A dominant alternative is one where all attribute levels are better than in the other alternatives in the choice set. That is a product which is cheaper, labelled campylobacter-free and outdoor bred. If a respondent has chosen the dominated alternative instead of the dominant alternative, she/he is characterised as been inconsistent and are eliminated.

[39] It is assumed that animal welfare is better with outdoor breeding than indoor. If a respondent does not agree, then an alternative that we consider dominant is not necessarily dominant in his eyes. Hence, removal of such respondents could lead to an overestimated willingness to pay for outdoor breeding. Whether or not these dominated answers are represented by this group of respondents has not been checked.

without information about campylobacter (A1), with information about campylobacter (A2), without information about breeding method (B1) and with information about breeding method (B2). The analyses are based on a sample of 2,301 respondents. This is the sample without protest answers and inconsistent respondents. Table 4.1, provides an overview over the data which has been included and excluded from the analysis.

Table 4.1. Presentation of data (on respondent levels)

		Sample A (Campylobacter)			Sample B (Animal welfare)			Total
Number	Text	A1	A2	Sample A	B1	B2	Sample B	
Respondents			**2090**			**2014**		**4104**
Opt out	Protest answers	40	38	29	45	61	33	246
	Below 40 DKK*			343			307	650
	Above 110 DKK*			5			9	14
	Don't know*			396			376	772
Inconsistent		41	15	3	37	23	2	121
In total		81	53	776	82	84	727	
Respondents in estimation			**1180**			**1121**		**2301**

Source: Own calculations

Notes:

1) Protest answers cover respondents who choose the opt-out alternative because they do not think it is their responsibility to pay for animal welfare or food safety. The protest answers are summarised as follows: Respondents only stating a protest answer in A1 (40), respondents only stating a protest answer in A2 (38) and respondents stating protest answers in both A1 and A2 are placed in the column "sample A" (29). The same notations are used for Sample B.
2) Respondents that have stated that they usually buy chicken below DKK 40 or above DKK110 are excluded from the analysis because our opt-out modelling does not allow that prices can take other values than given in the choice sets (between DKK 40 and DKK 110). Respondents stating that they do not recall their latest purchases of chicken are excluded due to potential difficulties with regard to rationality. These variables are identical for A1 and A2 (and B1 and B2, respectively) as the respondents are only asked once.
3) Inconsistent answers include dominated choices. The same logic is used to present inconsistent answers as was used to present protest answers. That is, 41 answered inconsistently only in sample A1, 15 answered inconsistently only in sample A2, and 3 answered inconsistently in both sample A1 and A2. Same logic applies for Sample B.

Each of the 2,301 respondents answered 8 choice sets which produces a total number of 18,408 observations. In the estimations, observations from the same respondent are

treated as coming from 4 different respondents with identical socio-demographics and background information[40].

4.4. Representativeness with respect to socio-demographic factors

First, the extent to which the sample can be compared to the data from Statistics Denmark is described. Next, the representativeness of the sample is tested by means of the *chi* test, below.

χ^2 – test

A χ^2 - test is a test concerning the independence between data. The test is based on the sum of quadratic deviations. The mathematical appearance of the test is as follows:

$$\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\left(A_{ij}-E_{ij}\right)^2}{E_{ij}} \qquad (4.1)$$

Where E_{ij} is the expected value of observation *ij* and A_{ij} is the actual value of observation *ij*. The χ^2-value is the probability that a value from the χ^2 statistics (Malmberg 1999), which is at least as large as the estimated χ^2-value, could have been contained by a random draw, under an assumption of independence (Skovgaard et al. 1999:253; Excel 2003). A large value (e.g. $\chi^2 = 10$) indicates independence between data, and $\chi^2 = 0$ indicates that the data being compared are identical. The number of parameters in the distribution are characterised as the degrees of freedom in the distribution. The χ test is widely used in statistical analyses. Examples of use of the *chi* test can be found in Hayes et al. (2002), Burton et al. (2004) and Mazzanti, M. (2003).

Gender

The data used in the survey, as well as by Statistics Denmark, include men and women in the age-group 18 - 99 years. Hence, gender in the two samples can be compared without pooling any groups. The actual number of men and women in our sample is compared with the distribution of the number of men and women that would be expected in the Danish population.

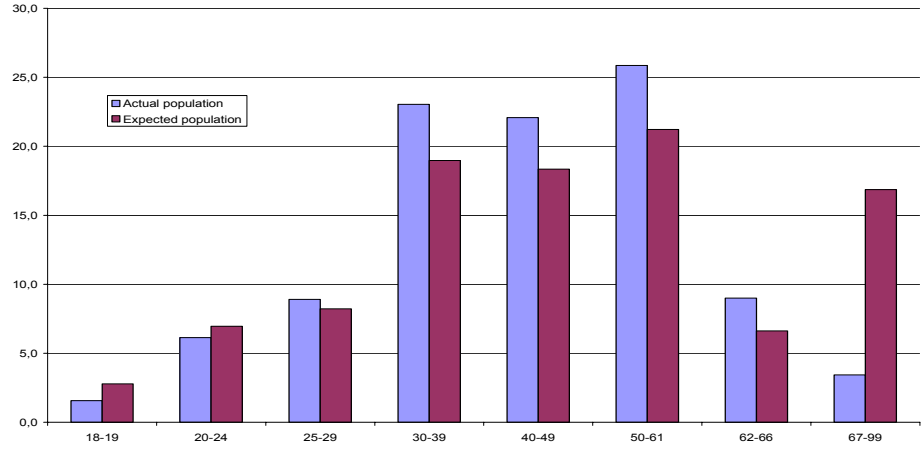
[40] That is, we do not use information that 1 respondent makes 4 choices to test whether variation within choices made by the same respondent is smaller than variation between choices made by different respondents.

Our sample has 47% women and 53% men whereas the general distribution is 49% women and 51% men. Whether these differences are statistically significant is revealed by testing the hypothesis that the two samples have the same distribution. The test result is χ^2 (1) = 4.8222. Thereby, the hypothesis is rejected and the data can be said to be significantly different at the *-level (5%-level). In short, the distribution of men and women in our sample is statistically different from the general gender distribution in Denmark. When testing datasets A and B separately, however, the gender distribution within each sample was found not to differ significantly from the gender distribution in Denmark (the test is shown in Appendix C).

Age

The same groupings are used in our sample as by Statistics Denmark. As a result, the age distribution of men and women aged between 18 and 99 years can be compared directly. In Figure 4.1, the age distributions from our sample and in Denmark as a whole are presented. If our sample was completely representative, then the distribution of the Danish population could be used to forecast the distribution of our sample (in Figure 4.1 this is denoted the *expected population*)[41]

Figure 4.1. The actual and expected age distribution of the sample



[41] For further explanations, see Appendix C.

With a test value χ^2 (7) = 342.29 we can conclude that the data are significantly different from the general age distribution in Denmark at a ***-level (0,1% level). Looking at the data more carefully reveals that the age group 67-99 years is underrepresented in our sample. Furthermore, the age group 25-39 years is overrepresented. The questionnaire was sent out to a representative sample of the Danish population, but the older age groups are lost in the answering procedure. The questionnaire was sent out to 646 respondents in the age group 67-99 years, and with a response rate at 51.2 %, 330 should have responded. However, only 79 were received and the reason may be the complexity of the questionnaire. Furthermore, the youngest group is also underrepresented. This could be due to the lack of interest in the subject of food safety and food in general. The overrepresentation of the age group 25-39 years is potentially due to their daily use of the internet or due to an increased interest of the subject food. The difference remains significant, however, even when these groups are removed.

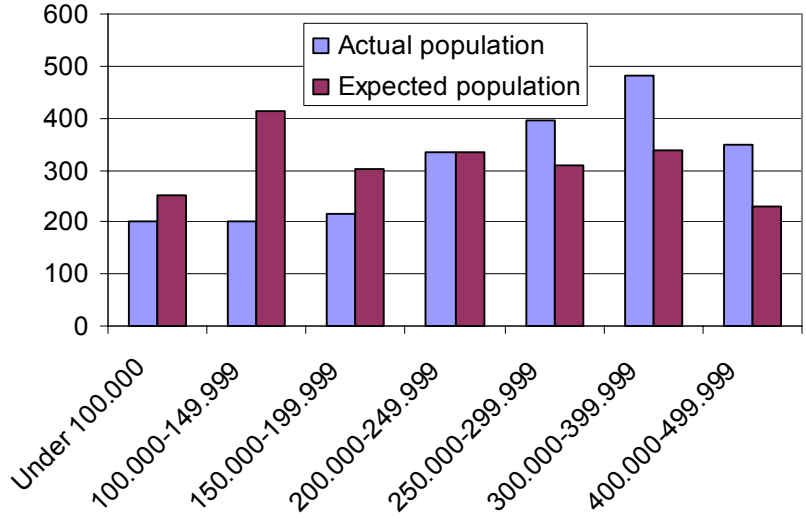
A test of the age distribution in samples A and B reveals that the age distributions in both samples differ from the age distribution in the population as a whole (see Appendix C).

Personal income

The sample data cannot be compared directly with data from Statistics Denmark. Both datasets are based on gross income, but the data from Statistics Denmark ranges from the age of 15 years whereas the age range in our sample is 18 years and above. It is not possible to eliminate the age group 15-17 years from the dataset from Statistics Denmark. Therefore, the average income from Statistics Denmark is lower than in the present sample, due to an expectation that the youngest age group's income is lower.

Moreover, to unify the basis for comparison, the two highest income groups in our sample are pooled. In Figure 4.2, the income distributions from the sample and for Denmark as a whole are shown (see also Appendix C).

Figure 4.2. Actual and expected income distribution for the sample – excluding the age group 18-19 and 15-19 respectively



With a test value at χ^2 (6) = 287.92, the two datasets are significantly different at the ***-level. In the sample dataset, individuals with high or medium income are over-represented, and individuals with low income are underrepresented. The overrepresentation of high income groups can have an influence on the results such that the willingness to pay estimates could be overestimated.

Where the age group 18-19 years is eliminated from the sample and the 15-19 years is eliminated from the data from Statistics Denmark, the comparability of the distributions improves, but the distributions themselves remain significantly different from each other.

Furthermore, the distributions in the samples A and B were tested individually and similar results were found. Therefore, these are not presented in this paper.

Education
The groupings in our sample are not totally comparable with the groupings used by Statistics Denmark. Statistics Denmark lists the highest education for age groups between 15 and 69 years, whereas our sample covers age groups between 18 and 99 years. In the data from Statistics Denmark it is not possible to include individuals older than 67 and it is not possible to exclude the groups from 15 to 17 without excluding the age group 18-19 years.

Moreover, to compare the data, two socio-demographic variables from the questionnaire (question Q7 and Q8 in the socio-demographic questions) have to be combined. The groups concerning primary school education in question Q7 is pooled with "none of these" in question Q8 to obtain one group of primary school educated respondents.

Finally, breaking the education levels down into "basic vocational education" and "completed vocational education" does not correspond to the groupings in Statistics Denmark. In order to compare these groups with the groups from Statistics Denmark, the two groups are pooled to a single category "vocational".

The *chi* test reveals that the data are significantly different at a ***-level. The high significant of this result is due to the way the data are pooled and the fact that the sample from ACNielsen was not mailed to a representative sample regarding education. A closer look reveals that highly educated (academic) respondents are overrepresented compared with the Danish population. This might also explain the overrepresentation of the medium and high income groups.

In Appendix C, the descriptive statistics for the divisions A and B are shown for the educational variable. Dividing the sample into these two groups does not change the conclusion – the educational distribution in the groups over represent academics and under represent other education types.

County
The sample can be directly compared with data from Statistics Denmark. With a test value at χ^2 (14) = 153.48, the county distribution of the sample is significantly different from the distribution of the Danish population.

A closer look at the single counties, reveal that Copenhagen municipality is very much overrepresented and that Storstrøms County, Viborg County and North Jutland

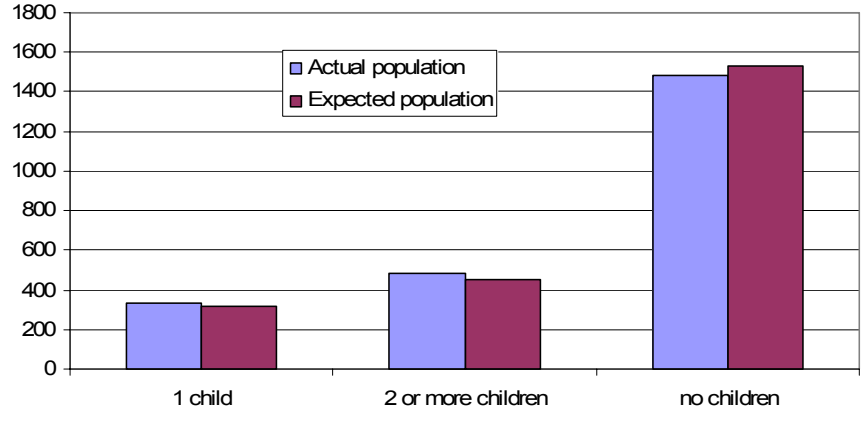
County are underrepresented. If these Counties are removed, the remaining counties are still not distributed in a representative way (see Appendix C).

Children

The number of children living at home for the respondents in our sample can be directly compared with Statistics Denmark's data. The basis is all men and women in the age 18 years or above. The distribution of children living at home is shown in Figure 4 in Appendix C.

The test value χ^2 (3) = 16.56, means that the distribution of children in our sample and SD?? are significantly different at the ***-level. From Figure 4 in Appendix C, the reason for this result could be the respective under- and overrepresentation of number of respondents with, respectively, 2 and 3 children. By pooling these two groups, the sample no longer differs significantly from the Danish population as a whole. The result of pooling the two groups is shown in Figure 4.3, below.

Figure 4.3. Actual and expected distribution of the number of children of the respondents in the sample when pooling two groups.



Summary of socio-demographic variables

The resemblance between our sample and the Danish population was not overwhelmingly satisfactory. In fact, gender and number of children in the household were the only two socio-demographic variables where the distributions are statistically comparable with the distribution apparent in the Danish population. A lesson has been

learned with respect to choice of socio-demographic variables. As Statistics Denmark has the most comprehensive database for descriptions of the Danish population and activities and, another time, greater emphasis would be given to matching their groupings.

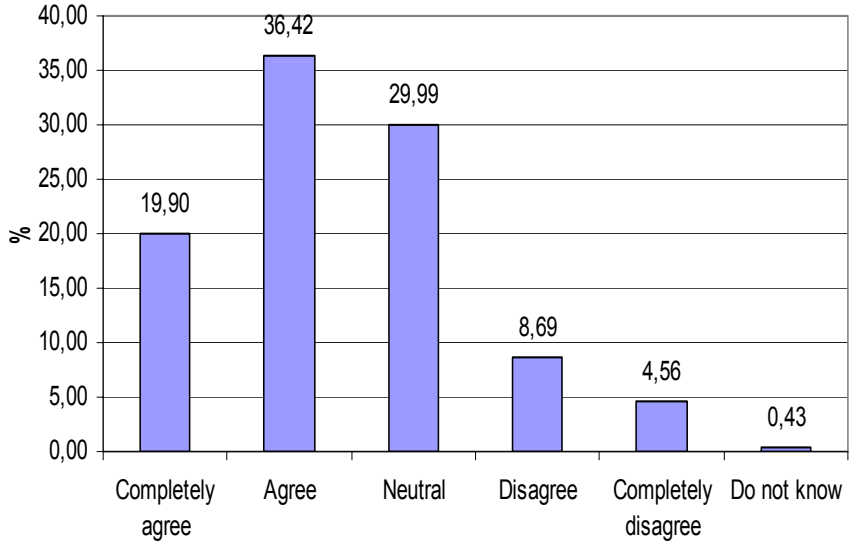
In summary our sample is overrepresented with respect to high income groups, academics, the age groups 30-60 and residents in Copenhagen. These are exactly the groups that could be expected to have higher willingness to pay for quality attributes of food products so the information will be used in the evaluation of the estimation results. The imbalance with respect to the respresentativeness of the sample is not so unusual, however. The same imbalance is found in Olsen et al. (2005); Hasler et al. (2005); Lundhede et al. (2005) and Ladenburg et al. (2005).

4.5. Attitudes

In this section the distribution of the attitudinal questions are put forward. The questions concern the attitude towards the importance of different food characteristics related to food safety and animal welfare, the source of information and consumer behaviour. The basis for the description is the 2,301 respondents, who all answered the questionnaire consistently and rationally, as described above. All distributions are shown as the percentage of the sample with the given attitude. The tables underlying the graphs are presented in Appendix C.

Figures 4.4 and 4.5 present examples of the type of results produced by the questionnaire. Figure 4.4 demonstrates that more than 55% find that breeding method is important, less than 15% find it unimportant and that 30% are neutral. Figure 4.5 shows that just over 50% find it important that a chicken is campylobacter-free whereas only 10% disagree (35% are neutral and the rest do not know).

Figure 4.4. Question 6: It is important that the product is campylobacter-free



The respondents state that important characteristics of the food they consume include low fat content, low campylobacter content, good animal welfare, domestic production and the appearance of the product (Figure C5-10 in Appendix C, Question 6) and 44% state that price is important. Also, 32% state it is important that the product is organic and 30 % of the respondents state that they purchase organic chickens as well as campylobacter-free chickens (Figure C6 and C37 Appendix C, Question 6 & 22). An interesting aspect is that whereas 70% of the respondents are aware that they can avoid campylobacter by good kitchen hygiene, 45% state that they would not wish to have campylobacter in their kitchen. This is despite the fact that contamination can be avoided with good kitchen hygiene (Figure C11 and C18, Appendix C, Question 7 & 15). This indicates that consumers simply do not want to have campylobacter inside their homes.

Most respondents agree with the statement that the outdoor breeding method is associated with higher animal welfare, whereas respondents are insecure with respect to the influence of breeding method on campylobacter contamination (Figure C13 and

C14, Appendix C, Question 14). This indicates that respondents do not perceive the two attributes as being interrelated – which is an indication of non-multicollinearity.

In general, the respondents consider the ongoing debate on animal welfare issues to be of great importance, whereas the debate on food safety issues as campylobacter seems to divide the population in two (Figure C15 and C19, Appendix C, Question 15). Moreover, the respondents state that it is the responsibility of the producers to secure the higher animal welfare and safe food products (Figure C20, Appendix C, Question 15). If the government could ensure a credible label, 50-60% of the consumers would be willing to pay more for a safer product from more animal-welfare oriented production (Figure C21 and C22, Appendix C, Question 15).

The respondents state that only information from the government or public authorities is credible, whereas information from the producers/industry divides the population in two – one group trusts them and the other group mistrusts them (Figure C26-32, Appendix C, Question 16).

Respondents are more familiar with salmonella than with campylobacter, 99.78 % were aware of salmonella, whereas only 84% were aware of campylobacter (Figure C33, Appendix C, Question 17 and 18). Almost one half of the respondents state that their knowledge of salmonella has influenced their answers regarding campylobacter (Figure C34, Appendix C, Question 19), which indicates that they might have difficulties distinguishing between salmonella and campylobacter or have interpreted the food safety aspect as a whole – not as campylobacter and salmonella, respectively. This is, furthermore, supported when the respondents state whether or not they buy chickens labelled campylobacter-free. 30% of the respondents state that they buy chickens labelled campylobacter-free (Figure C38, Appendix C, Question 22). This share seems relatively large. Finally, the average market price for chickens bought by respondents was DKK 57.

Finally, the respondents' perception of their own health is dependent on their age – the older they are the greater they perceive the risk of getting infected with campylobacter (Figure C39 in Appendix C).

5. Estimation of consumer behaviour

5.1. Introduction

In this chapter, consumer behaviour is investigated based on the choice experiment data. The first four sections describe the estimation process. In Section 5.2, present preliminary non-parametric analyses of the relationship between the price attribute and the frequency of choice are presented. In Section 5.3, the case for use of the probit model and dummy coding is made. In Section 5.4, the econometric analysis concerned with testing significance of explanatory variables and merging sub-samples is presented. The entire testing process, from the basic to the final model of consumer behaviour, involves seven models – all included in Section 5.4.

The last three sections describe and discuss the results. In Section 5.5, the final and most important models are presented and commented upon. The results of the final models are stated in terms of willingness to pay estimates (whereas during the modelling process in Section 5.4, the marginal utilities of the attributes are considered). In Section 5.6, individual specific variables are included to obtain more detailed information on differences in behaviour across consumer types. These include socio-demographic characteristics, respondent characteristics and stated attitudes.

5.2. Non-parametric analyses

By means of non-parametric analyses, it is possible to assess how the frequency by which a chicken is chosen relates to the price levels of the chickens. This type of analysis provides an intuitive illustration of a simple demand curve for chicken meat, when the product is only described by its price (differences in the other attribute are not considered). Figures 5.1 and 5.2 show the total cumulative number of times a chicken is chosen as a function of its price in the two samples – A and B. Sample A is the sample where information regarding campylobacter is provided, while Sample B is the sample with information of animal welfare provided. The cumulative number of choices before and after the information for each of the two samples is the same (approximately 4,500). This is due to the fact that each respondent has answered the same number of choice sets with and without information.

Figure 5.1 and 5.2 illustrate well that the demand for chicken decreases with increasing price. Figure 5.1 illustrates the cumulative choices in sample A, before and after information regarding campylobacter is provided. Figure 5.2 shows cumulative choices in sample B, before and after information regarding animal welfare is pre-

sented. Furthermore, Figure 5.1 and Figure 5.2 illustrate how the choice of chicken is affected by information provision. Thereby, the graphs provide rough indications on whether information affects the consumer behaviour.

Figure 5.1. Relation between price (in DKK) and frequency of chosen alternative for the respondents who received information regarding campylobacter (sample A).

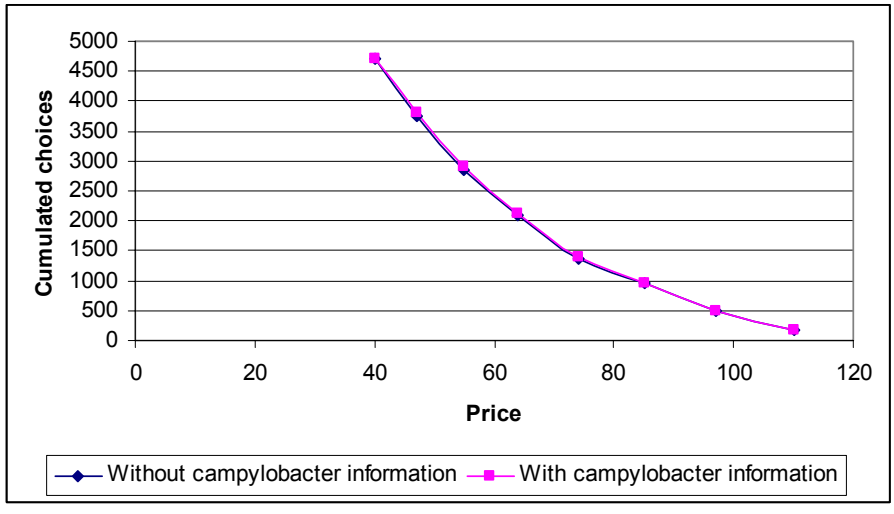
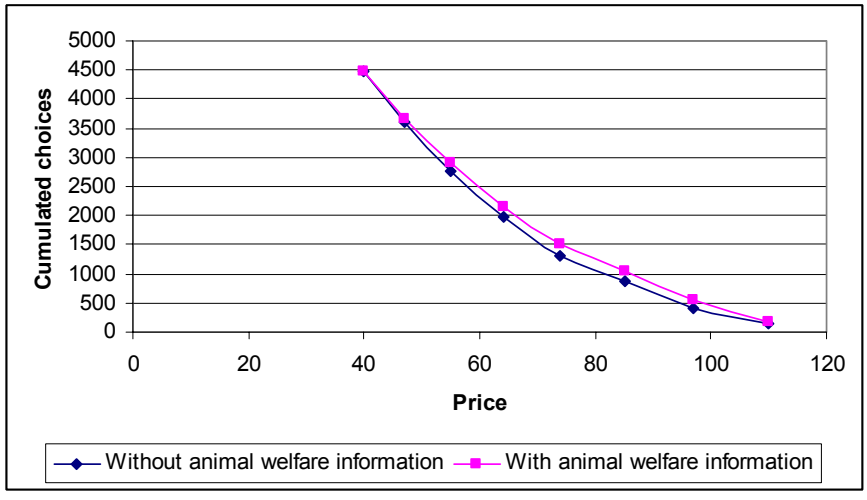


Figure 5.1 indicates that the choice of chicken does not change after information regarding campylobacter is given - this indicates that there is no information effect regarding campylobacter for a chicken that is only described by its price.

Figure 5.2 reveals that provision of information regarding animal welfare has some effect on consumer behaviour as more respondents choose chicken at the higher price levels after information regarding animal welfare is given. Hence, Figure 5.2 indicates that the price is *not* the only factor that determines the choice of chicken – breeding information, at least, also affects the choice.

Figure 5.2. Relation between price (in DKK) and frequency of chosen alternative for the respondents who received information regarding animal welfare (sample B).



The demand curves in Figure 5.1 and 5.2 also indicate that the choke price of 110 DKK has not been set perfectly, as the maximum price of 110 DKK was chosen roughly 700 times, corresponding to a rate of 3%. Apart from, of course, an ideal situation, where the choke price is not chosen by any respondents, no exact limits apply for the percentage which is acceptable. As a rule of thumb, this should be less than 5% of the total number of choices. Hence, according to this rule of thumb, our maximum price can serve as an acceptable choke price. Furthermore, only 14 respondents state that they usually buy chicken at prices above 110 DKK (cf. Table 4.1) which also indicates that our choice of maximum price is close to the choke price. In actual fact, a potentially more serious problem is that more than 15% of the respondents state that they usually buy chicken below the minimum price of 40 DKK (see Table 4.1). This indicates that our minimum price is too high which might result an overestimated WTP.

The above observations can also be formulated in terms of *price sensitivity*. Figure 5.2 shows that the number of times a chicken at a certain price is chosen is more stable after information about breeding methods has been given than before. Hence, it

can be said that the choices are less sensitive to price change, after breeding information is given. In general, small price sensitivities reflect that other attributes than the price are important (and *vice versa*, large price sensitivities represent preferences where price is an important attribute).

These relationships between choice of chicken, prices and information provide simple overviews of the choice behaviours. This might be too simple an overview, as, by employing the choice experiment method, it is assumed that choice of food products is not based on a single factor (price). Consumer behaviour is a result of a complex decision process where a myriad of factors are taken into account – with or without the consumers being aware of the importance of the individual factors. These complex patterns can be identified by engaging in statistical analyses that allow us to include multiple factors simultaneously. Thereby, the significance and magnitude of the effect that each of the individual factors has on consumer choice can be determined. This is carried out in the following sections.

5.3. Choice of econometric model

A random utility presentation of a discrete choice model is typically analysed using either a logit or a probit model. These include binary logit, multinomial (also denoted conditional logit), nested logit, mixed logit and probit[42] models. Binary logit models are restricted to analyses of binary choices and allow only very restricted substitution patterns between alternatives. Their popularity in earlier discrete choice surveys is mainly due to the closed form solution of the probability density function. Over the last two decades, however, a rapid increase in the computational powers of computers and increased focus and research in discrete choice models has opened up for a much wider range of models that can be used to estimate more complex consumer behaviour. These can allow for heterogeneous consumers and more complex substitution patterns between alternatives. Today, simulation is an important tool in estimating discrete choice models as only the simplest models do not involve open integrals (Munizaga et al. 2000).

Important properties of choice models

In relation to consumer behaviour, it is found that an operational method for choosing an econometric model is based on its capability of including taste variations, flexibil-

[42] When referring to probit, multinomial probit is actually meant, as opposed to binary probit since the choice sets involve more than 2 alternatives.

ity in substitution patterns, and correlations across time as well as across alternatives (Train 2003). These properties are described, in turn, below.

Random taste variation: In a standard logit model (binary, multinomial logit), it is implicitly assumed that preferences are identical for all consumers. Mathematically, this means that all individual specific variables "drop out" when utility differences between alternatives are calculated. Therefore, taste variations linked to observed, as well as unobserved variables, cannot be examined *directly* in a standard logit model. However, individual specific variables linked to observed variables might interact with alternative specific attributes – hence, by considering cross effects, identification can be made of how marginal utilities of an attribute depend on different individual factors. For example, interacting gender with the animal welfare attribute would generate information about the marginal utility of animal welfare as a function of gender. This is a simple approach that provides insight into the heterogeneity of consumers. Altogether, Holmes & Adamowicz (2003) mention three ways to modify the assumption of identical consumers: 1) by including interaction effects with observed variables (as mentioned above) 2) by estimating a latent class model or 3) by using a random parameter/mixed logit or probit model. In short, all the above-mentioned models can include taste variation when this is linked to observable variables (such as socio-demographic variables), but only mixed logit and probit can include differences in tastes that are linked to unobserved characteristics (unobservable personal characteristics).

Independence of irrelevant alternatives. A standard logit model requires independence between the ratios of probabilities of choosing any two alternatives of the availability of other alternatives. This is also formulated as the model exhibiting independence from irrelevant alternatives (IIA) (Holmes and Adamovicz, 2003, Footnote 17)[43]. Mixed logit and probit models do not exhibit independence of irrelevant alter-

[43] The restrictive nature of the IIA assumption is often illustrated by the red-bus/ blue-bus problem (Ben-Akiva & Lerman 1985). Consider a choice between going to work by car or with a blue bus. For simplicity, assume that the utility for the two means of transport and the probabilities are equal (to ½) such that the probability ratio is one (Pc/Pbb=1). Now a new bus is introduced, a red bus. One would expect this would not affect the probability of choosing the car, but that the probability of choosing a bus would be shared between the two types of buses ($P_{rb} = P_{bb} = 1/4$). However, when using a logit model, the probability ratio between the car and the blue bus has to remain one. The only probabilities where these ratios are one are when $P_c = P_{bb} = P_{rb} = 1/3$. This only reflects a real life situation if the bus colour matters. If the colours do not matter, a logit model would overestimate the demand for the two bus modes.

natives[44]. The property only causes problems when the individuals are faced with more than two alternatives in the choice sets (Train 1986; Freeman 1993).

Correlation of unobserved variables. A standard logit model requires independence of unobserved factors (Train, 2003). Mixed logit and probit models allow unobserved factors to be correlated across choice sets or over time (panel data characteristics).[45] If the unobserved factors that affect decision-makers are independent over repeated choices then a standard logit can be used to examine panel data in the same way as purely cross-sectional data (Train, 2003, p. 55). In this respect, the standard logit models can be interpreted as the perfect models – in that, if all relevant variables are included successfully in estimation of the choice decision, then only white noise is left (Train, 2003, p. 39). However, if the researcher thinks that the unobserved portion of utility is correlated over alternatives, given the specification of the observed part of utility, then the researcher has 3 options: to use a different model that allows for correlated errors (for, example mixed logit or probit) 2) to re-specify the model 3) to use the logit under the present specification, considering the model to be an approximation (Train, 2003, p. 40).

Choosing the probit model

The choice of model in the present analysis is based on an assessment of 1) how important the above mentioned properties are in relation to our analysis, 2) the statistical fit of the models, and 3) how well the models capture the decision structure that the respondents seem to using.

First, random taste variation was considered. As it was the intention to include only heterogeneity between consumers that is linked to observable variables, the random taste variation is not an important restriction. Second, the decision structure was assessed and the nested logit and multinomial logit were compared. The statistical fits were very similar, so the models could not be distinguished on that criteria. The con-

[44] Luce (1959) considered IIA as an assumption of the logit model, which he used to derive the logit model from (Train 2003). In the later literature, the property of IIA has been seen as a resulting property of the logit model instead of an assumption of the model (Train 2003).

[45] Train (2003) p. 55. In a market research survey, respondents are often asked a series of hypothetical choice questions called stated preference experiments. For each experiment, a set of alternative products with different attribute levels is described, and the respondent is asked to state which product he would choose. A series of such questions is asked with varying attribute levels so as to determine how the respondents choice changes when the attribute level changes. The researcher, therefore, observes a sequence of choices by each respondent. Data that represents repeated choices just as these are called panel data.

sumers face 3 choices in each choice set (2 real alternatives and an opt-out). As reflection of a real shopping situation with a well-known good is aimed for, it is most likely that the characteristics of the two real alternatives affect a decision of whether to buy it or not. This means that a nested logit is not suitable[46]. Therefore, it was found that the decision structure that respondents can be expected to use is better captured by a multinomial logit than a nested logit. Thirdly, the IIA is addressed. The opt-out alternative was chosen 15% of the time (2,792 times out of 18,408), so it must be concluded that the presence of the opt-out alternative has influenced the choice between the two alternatives. This means that it cannot be assumed that the choices between the two real alternatives would have been the same if the op-out option had not been present. Therefore, it is not appropriate to use a standard logit due to the exhibition of IIA. Finally, the choice comes to one of a probit or mixed logit model. The probit model produced the best statistical fit – hence, this is the model chosen in the estimations. The underlying models and tests are found in Appendix G. An overview over the typical models used in discrete choice modelling is provided in Table 5.1.

Table 5.1. Overview over econometric models and their relation to the preference structure

Restriction on the preference structure	Comments	Type of econometric model			
		Binary and multinomial logit	Nested logit	Mixed logit	Probit
Random taste variation can be linked to unobservable variables	Heterogeneity across consumers can be captured	No	No	Yes	Yes
Requires independence from irrelevant alternatives	Strong restriction on consumers choice	Yes	Not IIA across nests	No	No
Correlation of unobserved factors	Panel data structure can be captured	No	No	Yes	Yes
Distribution of error term		Gumbel	Gumbel	Anything	Normal

[46]If all alternatives are included simultaneously in the decision-making, and if the choice between alternative is not affected by introduction of additional alternatives, then a conditional logit is appropriate. Let us consider our choice experiment where respondents are faced with choice sets that include real alternatives and an opt-out alternative. If the respondents only choose to opt-out to a *status quo* or to zero if the real alternatives are not attractive enough, then the real and the opt-out alternatives are to be considered as alternatives with equal substitution. If this is the case, a conditional logit model can be used (Lauridsen 2005).

Choice of coding and opt-out

A dummy coding scheme is chosen with an alternative specific constant describing the opt-out alternative (the choice between dummy and effect coding is discussed in Appendix D and E).

The respondents stated in the questionnaire the kind of chicken they normally would buy and the price of this chicken. This information has been interpreted as the respondents' own opt-out values which represents the chicken product they opt-out to (Appendix E).

5.4. Estimating consumer behaviour

The estimation procedure in this section takes us through seven models distinguished according to how attributes and information affect consumer choice. An overview of the models might ease the reading. Below, the main characteristics of the models are stated.

1. Attributes with and without campylobacter information affect consumer choice (Sample A).
2. Attributes with and without breeding information affect consumer choice (Sample B).
3. Consumer choice is not affected by campylobacter information (Sample A).
4. Consumer choice is affected by breeding information (Sample B).
5. There are no differences between attributes without information (Samples A and B are merged)
6. Description of consumer choice without distinguishing between information levels (Samples A and B).
7. Consumer choice depends on the joint effects of the attributes and breeding information (Samples A and B).

The first 4 models are analysed separately in samples A and B. The last 3 models are analysed in the joined data set. *Model 7 is the final model, but all 3 models in the joined data set are interpreted and discussed with respect to the willingness to pay estimates in Section 5.5.*

The econometric analysis of consumer choice is based on the choice of model in Section 5.3. A multinomial probit model is used, using a dummy coding scheme with an

alternative specific constant describing the opt-out alternative. This model is used to estimate the main effects, as well as the interaction effects.

5.4.1. The basic main effect model

In the basic model, the attributes for animal welfare and food safety in the 4 datasets (A1, A2, B1, B2) are different attributes. In each of the 4 datasets 3 attributes are included (animal welfare, food safety, and price) to test for main effects. For example, it is assumed that animal welfare actually covers 4 attributes, namely animal welfare with and without campylobacter information and animal welfare with and without breeding information. An overview of the explanatory variables (including 12 attributes and 4 alternative specific constants) in the four datasets is provided in Table 5.2.

Table 5.2. Overview over the explanatory variables in the basic model.

	Sample A (campylobacter information)	**Sample B (breeding method information)**
Before information	A1 Breeding method without campylobacter information (s_{1ij}) Campylobacter contents without campylobacter information (s_{2ij}) Prices without campylobacter information (s_{3ij}) Alternative specific constant without campylobacter information (ASC_{1i})	B1 Breeding method without breeding information (s_{7ij}) Campylobacter contents without breeding information (s_{8ij}) Prices without breeding information (s_{9ij}) Alternative specific constant without breeding information (ASC_{3i})
After Information	A2 Breeding method with campylobacter information (s_{4ij}) Campylobacter contents with campylobacter information (s_{5ij}) Prices with campylobacter information (s_{6ij}) Alternative specific constant with campylobacter information (ASC_{2i})	B2 Breeding method with breeding information (s_{10ij}) Campylobacter contents with breeding information (s_{11ij}) Prices with breeding information (s_{12ij}) Alternative specific constant with breeding information (ASC_{4i})

Note: The indices *ij* refer to individual *i* and alternative *j*.

Our basic model is built upon the hypotheses:

- H_1 The attributes before and after receiving campylobacter information have significant effects on the choice probability (the coefficients are significantly different from zero) (Sample A)

- H_2 The attributes before and after receiving breeding information have significant effects on the choice probability (the coefficients are significantly different from zero) (Sample B)

The coefficients are estimated using a maximum likelihood approach. The estimations are carried out for the two datasets, A and B, separately as the datasets involve different respondents. Testing the significance of attributes with and without information, on the other hand, can be performed within a sample. The model related to Sample A that is described in the formula (5.1), includes 6 attributes, 2 alternative specific constants and an error term. Similarly, the model related to Sample B is described in (5.2):

$$U_{ij} = \sum_{k=1}^{6} \beta_k s_{kij} + ASC_{1i} + ASC_{2i} + \varepsilon_{ij} \qquad \text{(Model 1)} \qquad (5.1)$$

$$U_{ij} = \sum_{k=7}^{12} \beta_k s_{kij} + ASC_{3i} + ASC_{4i} + \varepsilon_{ij} \qquad \text{(Model 2)} \qquad (5.2)$$

where the first index k refers to attribute (k=1,..,12), second index i refers to individual (i=1,.., 18408), and third index j refers to alternative (j=1,.., 32). The attribute (s_{kij}) for attribute k and individual i in alternative j and the alternative specific constants are defined in Table 5.2. The error terms ε_{ij} are jointly normally distributed.

The two levels in each of food safety and animal welfare are dummy coded as 0 and 1, respectively. For example, for the animal welfare attribute (that is for k=1,4,7,10), the dummy coding involves s_{kij}=1 if animal welfare is characterised as 'outdoor' for individual i in alternative j and s_{kij} =0 if the animal welfare level is characterised by "indoor''. Similarly, for food safety (k=2,5,8,11), s_{kij} =1 if food safety is "campylobacter-free" for the i's respondent in alternative j and s_{kij} =0 if the food safety level is "not labelled". Thereby, in general, the coefficients are interpreted as additional utility above level 0. The price attribute is a discrete variable that can obtain 8 different values – it is modelled as a continuous variable. The *ASC* is interpreted as the value of everything that is not captured in the attributes, which can be interpreted as the (dis)utility of not choosing any of the two constructed alternatives provided (the marginal utility of opting-out, see also Appendix E).

The estimation results are summarised below in Table 5.4. The tests showed that all parameter coefficients are significant and the signs of the coefficients are all as expected (the price coefficient and the coefficient for the alternative specific constant are negative, the rest being positive), and that the hypotheses H_1 and H_2 can be accepted.

If it is accepted that the hypotheses result in Model 1 (Sample A) and Model 2 (Sample B), then it is stated that food safety, animal welfare and price (all attributes considered with and without information) have significant effects on consumer choice.

5.4.2. Effect of information

The next step is to test whether some of the attributes are considered identical by consumers. Samples A and B are kept separate. The aim is to test whether consumers distinguish between the attributes without and with campylobacter information in Sample A and whether they distinguish between attributes without and with breeding information in Sample B. Based on the preliminary non-parametric statistic analyses performed in Section 5.2, the following hypotheses are formed:

- H_3 The coefficients before and after receiving campylobacter information in Sample A are not distinguishable (campylobacter information does not affect the consumers' choice).
- H_4 The coefficients before and after receiving information about production systems in Sample B are distinguishable (breeding information does affect the consumers' choice).

These hypotheses can be tested through a t-test (Bech et al. 2004), using the Delta method described by Hanemann & Kanninen (1998). For Model 1 and Model 2, respectively, the coefficients of the attributes with information, and without, are tested against each other. The t-test is a generalised form of the ordinary Students t-test, where the t-value is calculated as follows:

$$t = \frac{\beta_1 - \beta_2}{\sqrt{s_1^2 + s_2^2}}$$

where s_1^2 and s_2^2 are the corresponding variance estimates. The test results are summarised in Table 5.3.

Table 5.3. Tests for whether attributes are perceived identical with – and without information in samples A and B.

	Model 1: Sample A		Model 2: Sample B	
	t-value	significance	t-value	Significance
Outdoor bred (with/without information)	-0.7125	**Ns**	-8.8091	***
Campylobacter-free (with/without information)	1.6106	**Ns**	1.2848	**Ns**
Price (with/without information)	-0.0712	**Ns**	-3.7142	***
ASC (with/without information)	0.7641	**Ns**	-1.8653	*

Note: For Sample A, information refers to campylobacter information whereas in Sample B, information refers to breeding information.

For the t-test in Sample A, Table 5.3 shows that there are no significant differences between the coefficients for attributes with campylobacter information, and without. This implies that there is no information effect with regard to campylobacter. In Section 5.6, an attempt is made to identify potential underlying reasons for this.

The above leads to the acceptance of H_3 which gives the main effect model for Sample A with the attributes food safety, animal welfare and price (without distinction between whether or not campylobacter information has been provided). This is termed Model 3 in Table 5.4.

For Sample B, who received information regarding breeding method, there are significant differences between the coefficients for attributes with information and without. More precisely, breeding information has a significant effect on marginal utility of animal welfare, but the marginal utility of campylobacter-free chicken is not affected by animal welfare information. The animal welfare information also affects the price sensitivity as consumers become less price-sensitive after having received information concerning animal welfare. This can be interpreted as consumers placing less importance on the price attribute and more importance on animal welfare after information about animal welfare is provided. These results make intuitive sense. Furthermore, the disutility of opting-out (captured by the ASC) becomes significantly lower when the information regarding animal welfare is given.

This leads to acceptance of H_4, which gives the main effect model for Sample B with the attributes animal welfare, food safety and price (all attributes depend on whether breeding information has been provided). This is termed Model 4 in Table 5.4.

5.4.3. Merging the two samples

The next step is to compare the two samples, A and B. The datasets A1 and B1 (that is, attributes without campylobacter and breeding information, respectively) are only distinguished from each other by being two different random samples of the population. It would be desirable to test the hypothesis that the coefficients for the two samples without information are identical. The hypothesis is supported by looking at Model 3 and 4 in Table 5.4 – it can be seen that the estimated coefficients before information is provided in Samples A and B are in the same range.

- H_5 The coefficients before information is provided about campylobacter (Sample A) are indistinguishable from coefficients before breeding information is provided (Sample B) (the two samples behave similarly).

Before the tests can be carried out, however, it is important to check for scaling, which occurs if the models reflect different underlying scales (Ruby et al. 1998). If there are no scaling effects between the two samples, A and B, then we can join the datasets A1, A2, and B1 (i.e. attributes without campylobacter information, attributes with campylobacter information and attributes without breeding information, respectively, are perceived by consumers in an identical manner.

It is desirable to test the following general hypothesis:

$$H_s : \beta_1 = \beta_2 \text{ and } \sigma_1 = \sigma_2$$

The variance differences are estimated under the assumption of parameter equality, followed by testing the assumption of equality of the parameters. The scaling test also gives a tool to correct for a possible scaling effect, by identifying the scale parameter, which can be used as "correcting" factor. In this project, the scaling issue is of concern when comparing the coefficients between Sample A and B (A and B1), and between the coefficients with and without information in Sample A (A1 and A2). The tests revealed that no scaling between the two samples exists, hence the Samples A and B1 can be joined. The scaling test is shown in Appendix F.

This leads to acceptance of H_5. This results in a main effect model in the joint dataset with the attributes animal welfare, food safety, and price (all attributes depend on whether breeding information has been provided). This is termed Model 5 in Table 5.4, where the estimate statistics are presented. Note that in Model 5, food safety without breeding information includes 3 attributes ("food safety without campylobacter information", "food safety with campylobacter information" and "food safety without breeding information"). Hence, Model 5 incorporates that information about campylobacter is not of importance to the consumer, and that provision information regarding animal welfare does have a significant effect on the probability of choosing a specific chicken product. Finally, the individuals become less price-sensitive and the disutility of opting out decreases when information regarding animal welfare is given. Model 5 can be written as:

$$U_{ij} = \sum_{k=7,8,9,10,11,12} \beta_k s_{kij} + ASC_{1i} + ASC_{4i} + \varepsilon_{ij} \tag{5.3}$$

where the variables are defined in Table 5.2

In short, Model 5 shows that food safety and animal welfare affect consumer choice and that animal welfare information affects tha valuation of these attributes. Model 5 is the resulting main effect model. The willingness to pay estimates will be presented for this main effect model in Table 5.6, together with the willingness to pay estimates for Models 6 and 7 (see below).

5.4.4. Main effects in the joint model without distinction between information levels

It has been demonstrated that consumers' perception of attributes change when breeding information is provided. Hence, there is no statistical justification for setting out a main effect model which does not include differences in information given to the respondent. Nevertheless, this model is included as a simple reference model of how the willingness to pay for food safety and animal welfare can be explained by the levels of these two attributes.

- H_6 The attributes food safety, animal welfare and price have significant effects on consumer choice (irrespective of whether information is provided).

The hypothesis is accepted which leads to Model 6, but it is seen from Table 5.4 that the statistical fit of Model 6 is not as good as of that of Model 5. Model 6 captures the effects of food safety, animal welfare and price on consumer choice (when the consumers' information levels are not known). The willingness to pay estimates for Model 6 will be presented as they provide an intuitive reference for the willingness to pay estimates that are established in the more detailed models (Model 5 and 7), see Table 5.6.

5.4.5. Cross effects in the joint model

The best main effect model is Model 5. Based on this model, cross effects are tested for. For example, this includes testing whether the willingness to pay for avoiding campylobacter depends on whether the chicken is raised indoors or outdoors. A model capturing the interaction between the two attributes, production system and campylobacter, is presented based on the following hypothesis:

- H_7 The coefficients for main as well as cross effects have significant effects on the choice probability.

More specifically, the hypothesis is tested in the following model:

$$U_{ij} = \sum_{k=7,8,9,10,11,12} \beta_k s_{kij} + \beta_{78} s_{7ij} s_{8ij} + \beta_{10,11} s_{101ij} s_{11ij} + ASC_{1i} + ASC_{4i} + \varepsilon_{ij} \quad (5.4)$$

where the main effects include food safety, animal welfare and price – all characterised with and without breeding information (as defined in Table 5.2), and the cross effects are defined as:

- The cross effect $s_{1ij}\, s_{2ij}$ is the joint effect of a chicken being raised outdoors and campylobacter-free without breeding information that individual i observes in alternative j.
- The cross effect $s_{10ij}\, s_{11ij}$ is the joint effect of a chicken being raised outdoors and campylobacter-free with breeding information that individual i observes in alternative j.

Similar to the coding of the main effects, the cross effect is dummy coded with the factor s_{kij}=1 if the j's alternative for individual i is outdoor and campylobacter-free whereas s_{kij}=0 in all other cases (campylobacter-free and indoor, not campylobacter

and indoor, not campylobacter labelled and outdoor). Hence, the coefficients should be interpreted as the extra value of campylobacter-free and outdoor compared with the levels that are dummy coded as 0.

Hypothesis H_7 is accepted leading to Model 7 of cross effects as presented in Table 5.4. The explanatory power of the models is very stable across models, with a slight increase from Model 5 to Model 7 (cf. Table 5.4). The willingness to pay estimates for the cross effect model are presented in Table 5.6.

Table 5.4. Summery of estimated models (The *standard deviations* are written in *italic*)

Model	1[1]	2	3[1]	4	5	6[2]	7
Choice	Sample A	Sample B	Sample A	Sample B	Sample A+B Main effects without information distinction	Sample A+B Main effect mode with information distinction	Sample A+B Cross effects mode with information distinction
Outdoor bred (without information)	0.58	0.65	0.55	0.65	0.61	0.72	0.40
	0.03	*0.03*	*0.03*	*0.03*	*0.019*	*0.02*	*0.04*
Outdoor bred (with information)	0.61	1.09	-	1.10	0.49	-	0.49
	0.03	*0.04*	-	*0.04*	*0.04*	-	*0.039*
Campylobacter-free (without information)	0.76	0.70	0.72	0.67	0.70	0.69	0.48
	0.03	*0.03*	*0.02*	*0.026*	*0.018*	*0.018*	*0.05*
Campylobacter-free (with information)	0.68	0.64	-	-	-	-	-
	0.03	*0.04*	-	-	-	-	-
Outdoor bred AND campylobacter-free (with information)	-	-	-	-	-	-	0.43
	-	-	-	-	-	-	*0.08*
Price (without information)	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
	0.001	*0.001*	*0.0007*	*0.001*	*0.0006*	*0.0005*	*0.0006*
Price (with information)	-0.03	-0.03	-	-0.03	0.005	-	0.005
	0.001	*0.001*	-	*0.001*	*0.001*	-	*0.001*
ASC (without information)	-1.78	-1.85	-1.85	-1.86	-1.88	-1.70	-1.87
	0.15	*0.163*	*0.14*	*0.16*	*0.11*	*0.10*	*0.11*
ASC (with information)	-1.93	-1.44	-	-1.44	0.51	-	0.51
	0.15	*0.15*	-	*0.15*	*0.06*	-	*0.063*
STD (opt-out)	-	-	-	-	2.12	2.06	2.07
	-	-	-	-	*0.11*	*0.11*	*0.10*
LRI	**0.2725**	**0.2706**	**0.2721**	**0.2705**	**0.2711**	**0.2652**	**0.2719**
N	**9440**	**8968**	**9440**	**8968**	**18408**	**18408**	**18408**
Log L	**-7545**	**-7187**	**-7549**	**-7188**	**-14741**	**-14860**	**-14725**

Note 1. For Model 1 and 3, information refers to campylobacter information whereas in Model 2, 4, 5, 6, 7, information refers to information regarding breeding method.
2) In Model 6, we have not distinguished between information levels in defining attributes 3) All coefficients are significant 0.1% level

5.5. Results on consumer behaviour

It is now time to present, interpret and comment upon the results. The model that provides the best explanation of consumers' willingness to pay for food safety and animal welfare is mainly characterised by that 1) it includes interaction between the attributes 2) breeding information affects attribute values and 3) campylobacter information does not affect attribute values.

The utility of a given chicken product can be described as a linear combination of the attributes (breeding method, campylobacter risk, joint effect of breeding method and campylobacter risk, and price) and a normally distributed error term. More specifically, in the final cross effects model, the utility of alternative *j* for individual *i* can be written as follows (with the variable names as described in Table 5.5).

$$U_{ij} = \sum_{k=7,8,9,10,11,12} \beta_k s_{kij} + \beta_{78} s_{7ij} s_{8ij} + \beta_{10,11} s_{101ij} s_{11ij} + ASC_{1i} + ASC_{4i} + \varepsilon_{ij}$$

(5.4 re-stated)

Table 5.5. Explanatory variables in the resulting cross effects model.

Variable name	Variable description	utility parameter	Description of coefficient
s_{7ij}	Breeding method without breeding information	β_7	Marginal utility of a chicken being bred outdoors compared to indoors when the chicken is not labelled (no breeding information)
S_{8ij}	Campylobacter contents without breeding information	β_8	Marginal utility of a chicken being campylobacter-free compared to not labelled when the chicken is bred indoors (no breeding information)
s_{9ij}	Prices without breeding information	β_9	Marginal disutility of product price (no breeding information)
ASC_{1i}	Alternative specific constant without breeding information		Marginal utility of opting out (no breeding information)
s_{10ij}	Breeding method with breeding information	β_{10}	Marginal utility of a chicken being bred outdoors compared to indoors when the chicken is not labelled (with breeding information)
s_{11ij}	Campylobacter contents with breeding information	β_{11}	Marginal utility of a chicken being campylobacter-free compared to not labelled when the chicken is bred indoors (with breeding information)
s_{12ij}	Prices with breeding information	β_{12}	Marginal disutility of product price (no breeding information)
ASC_{2j}	Alternative specific constant with breeding information		Marginal utility of opting out (no breeding information)
s_{1ij} s_{2i}	Outdoor bred and campylobacter-free without breeding information	$\beta_{7.8}$	Marginal utility of a chicken being bred outdoors as compared to indoors when the chicken is campylobacter-free in excess of the marginal utility of outdoors compared to indoors when the chicken is not labelled (no breeding information) OR EQUIVALENT TO Marginal utility of a chicken being campylobacter-free as compared to not labelled when the chicken is bred outdoors in excess of the marginal utility of campylobacter-free compared to not labelled when the chicken is bred indoors (no breeding information).
s_{10ij} s_{11ij}	Outdoor bred and campylobacter-free with breeding information	$\beta_{10,11}$	Marginal utility of a chicken being bred outdoors as compared to indoors when the chicken is campylobacter-free in excess of the marginal utility of outdoors compared to indoors when the chicken is not labelled (with breeding information). Marginal utility of a chicken being campylobacter-free as compared to not labelled when the chicken is bred outdoors in excess of the marginal utility of campylobacter-free compared to not labelled when the chicken is bred indoors (with breeding information).

Up until this point, the results have been presented in terms of marginal contributions of the attributes to the overall utility of a chicken. The most important findings will now be highlighted in terms of the more intuitive measure, namely *willingness to pay* for the individual attributes. It should be kept in mind that differences in willingness to pay can be due to differences in the marginal utility OR differences in price sensitivity. Furthermore, it is important to bear in mind when interpreting willingness to pay estimates (and the marginal utilities upon which these are based) that they indicate partial values "holding everything else equal".

The results are presented as averages across consumers – or as the behaviour of an average consumer. The average willingness to pay for two attributes of a chilled chicken are estimated as averages across all respondents, i.e. the willingness to pay for a chicken labelled campylobacter-free as compared to a chicken that is not labelled, as an indicator of preferences for food safety, and willingness to pay for a chicken from an outdoor production as compared to indoor, as an indicator of preferences for animal welfare. Furthermore, the extent to which these measures were affected by introducing expert-based information to the respondents has been investigated – once again as averaged effects across all respondents. In order to present the willingness to pay estimates as intuitively as possible, 3 important models of increasing complexity are discussed. The willingness to pay estimates are presented in Table 5.6.

- Willingness to pay for animal welfare and food safety for an average consumer explained by main effects, when differences in information are disregarded (Model 6)
- Willingness to pay for animal welfare and food safety for an average consumer explained by main effects, when differences in information are included (Model 5)
- Willingness to pay for animal welfare and food safety for an average consumer explained by main and cross effects when differences in information are included (Model 7).

Table 5.6. Summery of the willingness to pay estimates in DKK

		Simple main effect model without information distinction	Main effect model with information distinction	Cross effect model with information distinction
Animal welfare	Outdoor bred	25	20	13
	Outdoor bred (with breeding information)		42	34
Food safety	Campylobacter-free	23	22	16
	Campylobacter-free (with breeding information)		26	19
Both attributes	Outdoor bred AND campylobacter-free			43
	Outdoor bred AND campylobacter-free (with breeding information)			70

Note: the willingness to pay estimates are calculated from the estimates in Table 5.4 by dividing the attribute coefficients with the price coefficients. The estimates are additional amounts for a chicken containing the given characteristics as opposed to not displaying the characteristics.

Main effect model without information distinction

An average consumer gains positive utility when buying an outdoor-bred chicken or when buying a campylobacter-free chicken. In monetary terms, the price premium for an average consumer has been estimated to be around 25 DKK for an outdoor-bred chicken (*hereafter referred to as willingness to pay for animal welfare*) as well as for avoiding campylobacter (*hereafter referred to as willingness to pay for food safety*). These estimates are based on choices when we do not distinguish between consumers with or without information about the attributes.

Main effect model with information distinction

The differences in information attributes are now incorporated. A main effect model is thereby obtained, in which the information effect can be tested. In short, it was found that information about animal welfare is of importance to the consumer – but not campylobacter information. Information provision regarding breeding methods almost doubles the utility of the animal welfare attribute, relative to no provision of information or provision of information regarding campylobacter. In monetary terms,

this means that, without information, food safety and animal welfare are valued very similarly (around 20 DKK), but when breeding information is provided, the value of animal welfare doubles (42 DKK in Table 5.6) This increases the understanding of consumer behaviour as we find that the WTP for animal welfare is not just 25 DKK- it is 42 DKK when breeding information is provided and 20 DKK when information is not provided. Said differently, when consumers buy outdoor-bred chicken, they are willing to pay up to 22 DKK for breeding information.

Food safety is not directly affected by breeding information, but an indirect effect is apparent through changes in the price sensitivity. Providing breeding information reduces consumers' price sensitivity which can be interpreted as their placing less importance on price and more emphasis on animal welfare after they learn more about the differences in the respective breeding systems. The lower price sensitivity causes a slight increase in the willingness to pay for food safety when breeding information is provided.

The relative valuations of food safety and animal welfare are thus affected by breeding information. Without breeding information, the willingness to pay for food safety and animal welfare are very similar. However, after breeding information is provided, the value of animal welfare is almost twice as high as that for food safety.

Cross effect model with information distinction

The best description of consumer behaviour is obtained when the effects of the two attributes are included jointly and when a distinction is made between attributes with and without breeding information. The willingness to pay for animal welfare and food safety should not, however, be analysed separately as these are interdependent.

Interpreting cross effects

First, the interactions effect when no breeding information is provided is examined. The average willingness to pay for an outdoor-bred chicken (without breeding information) is found to be 20 DKK when interactions are not included. But – when interactions are included – outdoor-bred willingness to pay becomes 13 DKK when the chicken has no campylobacter label and 43 DKK when the chicken is campylobacter-free.

Similarly, the willingness to pay for avoiding campylobacter (without breeding information) is not simply 22 DKK – but 16 DKK when the chicken is raised indoors and 43 DKK when the chicken is raised outdoors.

The direct sum of the WTP for food safety and animal welfare is 29 DKK, but the joint value of food safety and animal welfare amounts to 43 DKK. This means that there is an extra willingness to pay of 14 DKK per chicken above the willingness to pay for the individual attributes. This result has nothing to do with the effect of information as it is the case without breeding information which is being considered. The result is simply driven by the nonlinearity of consumers' preferences for food safety and animal welfare.

Second, the cross effect when breeding information is provided is examined. An average consumer is not just willing to pay 42 DKK for outdoor, compared with indoor, bred chickens – the average willingness to pay for an outdoor chicken is 34 DKK when there is no campylobacter label and 70 DKK when the chicken is campylobacter-free. Moreover, the willingness to pay for avoiding campylobacter when breeding information is provided is not simply 26 DKK – it is 19 DKK when the chicken is raised indoors and 70 DKK when the chicken is raised outdoors.

Altogether, the willingness to pay without breeding information are 13 DKK for outdoor-bred, 16 DKK for campylobacter-free and 43 DKK for both attributes. With breeding information, the willingness to pay estimates are 34 DKK for outdoor-bred, 19 DKK for campylobacter-free and 70 DKK for both attributes. A very clear indication of consumers' preferences being non-additive in quality attributes is provided. This result should be investigated further in relation to other quality attributes, as well.

Interpreting information effects

With respect to information, the overall conclusions of the main effect and the cross effect models are the same – i.e. there is no effect from providing campylobacter information, but provision of information regarding breeding methods more than doubles an average consumer's utility of animal welfare. The demand for chicken is less price elastic after the information regarding breeding methods is received, which can be interpreted as price becoming less important in the consumer's selection process after breeding method information is provided (see also Appendix C, Figure C42). The reduction in price elasticity due to provision of breeding information affects the willingness to pay for food safety due to the increased marginal rate of substitution.

Note that the monetary value of information in the cross effect model differs from the value of information found in the main effect model, since the value of information depends on the level of animal welfare as well as the level of food safety.

The value of breeding information when buying outdoor-bred chicken is not simply 22 DKK as we found in the main effect model, but 21 DKK when the chicken's campylobacter content is not known and 27 DKK when the chicken is campylobacter-free. Similarly, when buying a campylobacter-free chicken that is bred indoors, the value of breeding information is 3 DKK, but when buying a campylobacter-free chicken that is outdoor-bred outdoors, the value of information is 27 DKK.

Looking at the trade-offs between animal welfare and food safety, the results show that the trade-off between animal welfare and food safety is close to 1:1 before information is provided. This indicates that consumers' preferences for the two attributes are very similar before breeding information is provided. After breeding information is provided, the preferences for animal welfare are stronger than those for food safety (for the particular case studied).

A summary of the price premiums are presented in Table 5.7, formulated as the overall price that the consumers state they are willing to pay for a standard chicken of 40 DKK with the extra attributes. For example, an average consumer would be willing to pay 53 DKK for outdoor-bred chicken. This implies that the consumer is indifferent in relation to an outdoor-bred chicken at 53 DKK that is not campylobacter labelled and a chicken raised indoors at 40 DKK without campylobacter label. However, if the indoor-bred campylobacter-free chicken was sold at a price below 53 DKK, then that would be preferred.

Table 5.7. Overview of estimated willingness to pay (in DKK) for a whole chilled chicken with specific attributes (from the resulting cross effects model).

	Animal welfare	Food safety	Food safety and animal welfare
Without breeding information	53 (33%)	56 (40%)	83 (107%)
With breeding information	74 (85%)	59 (47%)	110 (175%)

Notes:
1) We can only display willingness to pay estimates for 6 attributes as the price is used as numeraire in the calculations.
2) The (%) capture the percentage price premiums that can be attributed to the specific attributes compared to an indoor bred chicken that has not been controlled for campylobacter which costs 40 DKK.

5.6. Consumer behaviour explained by personal characteristics

The average measures of willingness to pay are examined in more detail by inclusion of respondent characteristics, e.g. socio-demographic variables and respondents' stated attitudes towards animal welfare and food safety. Technically, this is carried out by including cross effects of the attributes (food safety and animal welfare), with the characteristics of the respondent in the statistical analysis. This makes it possible to identify the way in which consumers' preferences vary across different groups and, furthermore, whether different groups are affected differently by the provision of expert information.[47]

5.6.1. Willingness to pay and personal characteristics

The results are described intuitively in the text below and subsequently summarised in Table 5.8.

WTP depends on the consumers' perception of the relation between production system and campylobacter

Consumers who do not believe that outdoor-bred chickens experience better animal welfare do not want to pay any price premium for an outdoor-bred chicken.

Consumers who believe that an outdoor-bred chicken has a higher risk of having campylobacter, have a lower willingness to pay for animal welfare than people who do not think that an outdoor-bred chicken has a higher risk of having campylobacter. Somewhat surprisingly, however, the willingness to pay for food safety is not affected by whether the consumer believes outdoor-bred chicken to have a higher campylobacter risk or not.

WTP depends on attitude towards organic farming

Consumers who prefer organic products are willing to pay more for animal welfare than those who have not stated that they prefer organic products. This relationship is as expected, because it is believed to be common knowledge that organic chickens in Denmark must have access to outdoor areas. Moreover, consumers who prefer organic products do not display a significantly different attitude towards food safety than other consumers.

[47] Using this procedure, we only include taste variations linked to observed variables (see also Train, 2003, p. 46).

WTP depends on information towards kitchen hygiene

Consumers who do *not* believe they can avoid a campylobacter infection by having good kitchen hygiene have a higher willingness to pay for food safety than consumers who *do* believe they can avoid campylobacter infections by having good kitchen hygiene. This result is consistent with a hypothesis where food safety is considered to be a quality of the final product that can be obtained either by securing food safety in the production process or by "decontamination" in the kitchen (campylobacter-free products are substitutes for good kitchen hygiene). An opposing behavioural hypothesis would be that people who have good kitchen hygiene are more concerned about food safety and, as such, are not willing to have campylobacter in the foodstuffs they use, even though campylobacter would not cause any risks due to their good kitchen hygiene. However, the latter hypothesis cannot be supported by our result.

Furthermore, consumers who do *not* think campylobacter infections can be avoided through good kitchen hygiene have a lower willingness to pay for animal welfare, but these effects are not easily interpretable.

WTP depends on confidence in Danish foods

Consumers who state that they are afraid of consuming foods produced in Denmark have a higher willingness to pay for food safety than those who are not afraid of consuming foods produced in Denmark.

WTP depends on attitudes towards how to support animal welfare and food safety

Respondents who state that they support animal welfare through their everyday choice of foodstuffs have a higher willingness to pay for animal welfare than people who state that they do not support animal welfare through their choice of food. This result indicates consistency.

Whether or not consumers think that it is the responsibility of the government to support animal welfare does not affect their willingness to pay for animal welfare.

This result does not hold with respect to food safety. Consumers, who state that food safety is the responsibility of the government have a higher willingness to pay for the food safety attribute than those who have indicated that it is not the responsibility of the government. These consumers think that it is the responsibility of the government and, at the same time, are willing to pay more for a safer good. This finding indicates

that where the government does not provide the safer product, these respondents are willing to carry the costs involved – up to a certain amount.

WTP depends on taste of outdoor chicken

In the introductory text in the questionnaire, it is explicitly stated that "apart from differences in campylobacter levels, production systems and price, the chickens are identical with respect to taste, packaging, etc." At the same time, the survey showed that respondents who feel that outdoor produced chickens taste better also have a higher willingness to pay for the outdoor-bred chicken. This indicates that part of the willingness to pay for an outdoor-bred chicken is potentially not due to the better animal welfare (the public good element), but due to the greater enjoyment of the private characteristics of the good (better taste). There are two possible explanations to aid interpretation here. The result may indicate that the respondents do not read/-remember the information provided in the questionnaire, with the result that the estimated values obtained for animal welfare actually include a value for the better taste. Alternatively, the respondents' answers can be interpreted as outdoor chicken *in general* tasting better, which does not preclude that they still remember that in the choice experiments all other attributes – including taste – were considered equal.

WTP depends on personal experience with campylobacter

The willingness to pay for food safety is not affected by whether or not consumers are aware of campylobacter (or salmonella, for that matter) – but this result changes when respondents have had personal experience with campylobacter infection. Consumers who have, themselves, experienced a campylobacter infection, or who are familiar with somebody who has, have higher willingness to pay for food safety than respondents without any experience with campylobacter infections.

Consumers who state that awareness about salmonella has influenced their answers have a higher willingness to pay for food safety than consumers who state that their knowledge of salmonella did not affect their choice. This result indicates that, on average, the willingness to pay for avoiding campylobacter is not affected by knowledge about salmonella. However, for a certain a group of consumers (those who specifically state that salmonella knowledge affects their choices), this knowledge does affect their willingness to pay for avoiding campylobacter.

Furthermore, consumers who answered that knowledge about salmonella had an influence on their answers are less price sensitive. This can be interpreted as these re-

spondents placing less importance on the price attribute and more on the food safety (and animal welfare) attributes.

WTP depends on health status

Respondents who think of their own health as being poor and who, therefore, consider themselves as more vulnerable in relation to illness displayed a higher willingness to pay for food safety.

WTP depends on gender and age

Male respondents in our analysis have a higher willingness to pay for food safety than women. This contrasts with Buzby & Skees (1994), who find that male respondents have a lower willingness to pay for food safety. The authors argue that this is because males only consider the risk as a private matter – this is, the risk is only to themselves and not to their family as well, whereas women include the whole family in their risk assessment, explaining their apparent higher willingness to pay for food safety. Ott (1990), on the other hand, did not find any difference between men's and women's willingness to pay for food safety in a study concerning pesticide residue-free products. Our result is potentially biased due to the dataset not being representative – hence, a strong conclusion of the effect of gender cannot be made.

The results show that consumers older than 50 years of age have a higher willingness to pay for food safety. This is in accordance with Hammit & Graham (1999), who found that age was positively related to the willingness to pay estimate, whereas this contrasts with Buzby & Skees (1994), who found that younger consumers were willing to pay more for reducing risk than older consumers. Hayes et al. (1995) value food safety using a young group of respondents. Here, it is stated that a possible explanation for the low willingness to pay estimates obtained for food safety might be due to a general lack of aversion to risk among younger people. This explanation is in accordance with the findings in the present survey. Older people may be more afraid of potential infection as they may become more susceptible and more vulnerable with age. The descriptive statistics in Appendix C demonstrate that this is the case – respondents above 50 years, on average, feel that their health is in a poorer state than that of respondents below the age of 50.

WTP depends on education and income

In the present study, higher educated respondents have a higher willingness to pay for animal welfare than respondents with lower education. Similarly, Huang et al. (1999) found that people with a higher education had a higher willingness to pay for food

safety. In contrast, however, Buzby & Skees (1994) found that less educated people were willing to pay more for food safety than those with a higher education and found no effect of educational level on the preference for food safety.

The willingness to pay is found in other studies to depend on the respondents' income level. Hammit & Graham (1999) found that income was positively related to the willingness to pay for health protection, in the form of a risk reduction from dying in a car accident. This was also found by Misra et al. (1991) in a study concerning consumers' willingness to pay for pesticide-free chilled produce, whereas Huang et al. (1999) found the opposite trend that consumers' willingness to pay for food safety decreased with income.

In the present survey, utility of food safety and animal welfare were not directly affected by income levels. However, the respondents with the highest income level were less price sensitive than the low income groups. Furthermore, those who did not state their income level were least price sensitive, indicating that this group might represent the group with the highest income level. The level of income had no effect on the utility of the other attributes – animal welfare and food safety – but while the price sensitivity decreased with income, the willingness to pay for animal welfare and food safety increased with income.

WTP depends on geography

The relationship between willingness to pay and geographical distribution (rural areas, towns and cities with less than 50,000 inhabitants and towns and cities with more than 50,000 inhabitants). It was found that people who live in rural areas have a lower willingness to pay for food safety compared with respondents who lived in cities. Furthermore, it was found that people who live in urban areas with up to 50,000 inhabitants have a lower willingness to pay for animal welfare than respondents from rural areas and urban areas with more than 50,000 inhabitants, respectively.

Test statistics of results on willingness to pay and personal characteristics

Table 5.8 shows the effect on willingness to pay of including socio-demographic and attitudinal variables in the model. Table 5.8 shows the full model including all significant interaction effects. The **bold** type parameters are the main effects, whereas the normal type parameters are the corresponding interaction effects – all tested at the 5% significance level.

The parameter values of the cross effects in Table 5.8 are to be interpreted as marginal value added relative to the main effect. In example, the marginal value added of an increase in the animal welfare attribute for respondents who do not believe that outdoor-bred chickens experience better animal welfare is -0.26. That is, utility for an outdoor-bred chicken for this group of consumers is 0.06 (=0.32-0.26), while the utility for the remaining respondents who are neutral or believe that outdoor-bred chicken experience better animal welfare is the 0.32 illustrated by the value of the main effect.

Table 5.8. Full model including interaction effects.

Choice	Coefficients	Std. Err	P-value
Outdoor bred	0.319500	0.078700	<.0001
x Outdoor provides no better animal welfare	-0.257600	0.079000	0.001
x Outdoor produces higher risk of campylobacter	-0.130500	0.047800	0.006
x Preference for organic food	0.306600	0.042900	<.0001
x Campylobacter not avoided with good hygiene	-0.201300	0.071000	0.005
x Buys food to support animal welfare	0.533300	0.044600	<.0001
x Outdoor tastes better	0.325300	0.038800	<.0001
x Food safety is producers' responsibility	-0.248900	0.046700	<.0001
x Food safety is government's responsibility	0.121500	0.023600	<.0001
x Higher education	0.099300	0.035100	0.005
x Town/city of up to 50,000	-0.131700	0.036300	<.0001
Outdoor bred (information regarding breeding method given)	0.580400	0.070100	<.0001
x Men	-0.236500	0.075500	0.002
x Buy food to support animal welfare	0.296600	0.085100	0.001
Campylobacter-free	0.179200	0.069700	0.010
x Campylobacter not avoided with good hygiene	0.275900	0.072500	<.0001
x Afraid of consuming Danish food	0.179400	0.045900	<.0001
x Buys food to support animal welfare	0.103100	0.039400	0.009
x Knowledge of salmonella has influence	0.542500	0.037700	<.0001
x Poor health	0.195900	0.096000	0.041
x Ill due to campylobacter	0.272100	0.044700	<.0001
x Food safety is government's responsibility	0.121500	0.023600	<.0001
x Men	0.156800	0.037600	<.0001
x Rural areas	-0.174600	0.057700	0.003
x Age 50+	0.173900	0.038600	<.0001

Outdoor bred AND campylobacter-free	0.288000	0.115000	0.012
Price	-0.057400	0.001157	<.0001
x Preference for organic food	0.007625	0.001189	<.0001
x Campylobacter not avoided with good hygiene	0.009749	0.001818	<.0001
x Food = Support for animal welfare	0.018400	0.001197	<.0001
x Outdoor = better taste	0.008311	0.001240	<.0001
x Knowledge of salmonella = influence	0.006407	0.001045	<.0001
x Poor health	0.013100	0.002360	<.0001
x Men	-0.002240	0.001052	0.033
x Age 50+	0.008029	0.001071	<.0001
Price (information regarding breeding method given)	0.006570	0.001710	<.0001
x Outdoor has better taste	-0.006177	0.002345	0.008
x Ill due to campylobacte	0.012400	0.002383	<.0001
Alternative Specific Constant (ASC)	-3.137000	0.148200	<.0001
ASC (information regarding breeding method given)	0.712000	0.090400	<.0001
STD(opt-out)	3.150100	0.139700	<.0001
LRI	**0.3299**		
N	**18408**		
Log L	**13552**		

5.6.2. The effect of information and personal characteristics

Campylobacter information has been found not to affect consumer behaviour, whereas information regarding animal welfare has. In this section, potential underlying reasons for this are explored. The effect of information is measured in relation to the willingness to pay: information has an effect on consumer behaviour if the willingness to pay changes after the information is provided.

Lack of effect with regard to campylobacter information

Our first hypothesis was that the information provided did not have any effect because the respondents had the knowledge beforehand. As the campylobacter information contained one part describing the illness and one part describing how to avoid

being infected through good kitchen hygiene, the novelty factor for both had to be tested.

As a proxy variable for whether new information about the illness was provided, the survey question of whether respondents had previous knowledge of campylobacter was used. If individuals with previous knowledge about campylobacter did not change willingness to pay for avoiding campylobacter after receiving campylobacter information (but those without previous knowledge about campylobacter did change their willingness to pay for avoiding campylobacter), then this would indicate that the merging of the two groups made the effect of information insignificant. No differences were found between the two groups of individuals with regard to the effect of campylobacter information. However, the test might be too imprecise to reveal whether information was new or not as it is not known what the respondents really mean by "being aware of campylobacter". It would have been better to ask directly whether or not the information provided was new to them.

The effect of respondents' knowing that campylobacter infections could be avoided through good kitchen hygiene was tested. Again, we found no differences in the effect of information between the subgroups that knew about kitchen hygiene and those who did not.

Another hypothesis is that, overall, the effect of campylobacter information was neutral. That is, the description of the illness could increase the willingness to pay, whereas the description of kitchen hygiene could decrease the willingness to pay – thereby counterbalancing each other's effect. Unfortunately, this hypothesis has not been able to be tested. In order to do so, the samples would have had to have been split, such that the 2 parts of the campylobacter information could have been provided separately.

It was tested whether socio-demographic differences could be used to explain the lack of an effect from the provision of campylobacter information. Gender, educational level, income, residence, age and whether or not the respondents had children were all tested – but we found no differences across socio-demographic variables in relation to the effect of campylobacter information.

Whether people who did not consider campylobacter a risk were less sensitive to information was investigated. Specifically, the questions of whether respondents perceived campylobacter as a risk and whether they found the discussion of campylobac-

ter had become out of proportion were used. Again, we found no differences in relation to the effect of campylobacter information for these subgroups.

The effect of animal welfare information

Provision of the animal welfare information was found to have an effect. However, it has not been possible to identify the differences in terms of to whether the respondents were provided with *new* information. The questionnaire contained a question regarding whether the respondents believed that chickens raised in outdoor systems have a higher welfare than chickens raised indoors, but this does not tell us whether the respondents knew the exact differences between breeding systems.

A potential reason for the high effect of animal welfare information is because outdoor-bred chicken is described only in positive terms, but no direct follow-up questions have been posed either to support or reject this hypothesis.

It was tested whether consumers who feel that the debate concerning animal welfare is too hysterical had reacted differently to animal welfare information than consumers who do not think the debate is too hysterical. Furthermore, use was made of the question of whether the respondents thought that the animal issue was handled too superficially to identify whether it would have an effect on the effect of animal welfare information. No significant differences in relation to the effect of animal welfare information were found in either case

The socio-demographic variables used to explain the effect of information were gender, educational level, income, residence, age and whether or not the respondents had children. The only significant effect found was that men's utility gain from receiving information regarding animal welfare was smaller than women's – that is, men responded less to the information. The remaining effects were all insignificant, indicating that particular socio-demographic groups did not respond to information concerning production systems differently.

With respect to attitudinal characteristics, we found that respondents who support animal welfare through their choice of food had a higher utility of receiving information about animal welfare.

Respondents who stated that an outdoor-bred chicken tasted better were less price sensitive than those who did not think that an outdoor-bred chicken tasted better. But after they had received information regarding animal welfare, they became more price

sensitive. This is potentially due to the reason that the information provided did not confirm better taste in an outdoor-bred chicken, so they became more aware of the price level.

Respondents who have been ill or know someone who has been ill due to campylobacter displayed a further decrease in price sensitivity after information regarding animal welfare was provided. This could indicate that they place less importance on price after receiving breeding information.

5.6.3. Summery of personal characteristics

The respondents seem to have acted reasonably consistently against expectations. Inclusion of background variables revealed a significant variation across consumer groups – a variation which is not captured when only estimates of the average population are used. In short, the following results were revealed:

Summary of results on willingness to pay and personal characteristics

- Consumers who do not believe that outdoor-bred chickens experience better animal welfare do not want to pay any price premium for an outdoor-bred chicken.
- Consumers, who believe that an outdoor-bred chicken has a higher risk of having campylobacter, have a lower willingness to pay for animal welfare.
- Consumers who prefer organic products have a higher willingness to pay for animal welfare.
- Consumers who do *not* believe they can avoid a campylobacter infection by having good kitchen hygiene have a higher willingness to pay for food safety
- WTP does not depend on knowledge about campylobacter (or salmonella, for that matter) – but personal experience with campylobacter increases the willingness to pay for avoiding campylobacter
- Consumers who think of their own health as being poor have a higher willingness to pay for food safety.
- Men have a higher willingness to pay for food safety than women.
- Higher education increases the willingness to pay for animal welfare.
- Consumers in rural areas have lower willingness to pay for food safety – the same picture is not found for animal welfare.

Summary of results on the effect of information and personal characteristics

There where two main results from the hypothesis testing regarding the effect of information: 1) the information regarding animal welfare had a significant influence on the consumers' behaviour and 2) the information regarding campylobacter did not have a significant influence on the consumers. The motives behind these conclusions have not been fully identified. One reason, which we have not been able to test for, is that the negative information on illness and the positive information on kitchen hygiene counterbalanced each others' effect. This could also (partly) explain the positive willingness to pay for the animal welfare information, which is entirely positive. No significant variations were found across socio-demographic variables with regard to the influence of information. Another potential bias of the results is inherent in the design. The same people are asked to perform a choice task, before and after information provision. This ensures that no differences other than information distinguish the two choice tasks. However, an element of "stubbornness" may arise, where respondents do not want to be caught being inconsistent just because they receive information. As a result, they may be relatively unwilling to change their behaviour, from one choice task to the next.

6. Discussion and perspectives

Our contribution

The novelty in our research lies in the joint assessment of the demand for food safety and animal welfare – and in our direct focus on how information affects demand. Food safety and animal welfare are common attributes and consumers make trade-offs between food safety, animal welfare and prices in their daily shopping for meat products. Nevertheless, a non-market approach has been used to estimate the respective values for these attributes as they are not traded individually and that, due to lack of information, the consumers are often not even aware of the trade-offs they make. Methodologically, a choice experiment method has been employed with integrated information provision, thereby adding to the very sparse literature on how information affects stated preferences.

It was found that campylobacter information did not affect the willingness to pay for either food safety or animal welfare and that breeding information had a considerable effect on the willingness to pay for animal welfare, but only a slight indirect effect on food safety through changes in price sensitivity. Furthermore, a significant willingness to pay for food safety and animal welfare was found and the values of the two attributes were found to be interrelated.

Market implications of our results

The results revealed an average willingness to pay for avoiding campylobacter in an outdoor-bred chicken of 43 DKK per chicken. Does that mean that the value of the Danish chicken market could be increased by 43 DKK for each chicken sold by focusing exclusively on outdoor-bred campylobacter-free chickens[48]? The answer has to be no as a range of elements should be considered before jumping to hasty conclusions in this regard.

Our results are created in a situation where a campylobacter-free chicken is readily available and accessible – and the consumer is instructed to focus on food safety, animal welfare, and price. This contrasts with a real shopping situation where these conditions are not necessarily present and where there is a myriad of trade-offs to be made. Furthermore, these trade-offs are sometimes not even known due to lack of information. For example, a salmonella-free chicken is not always labelled because it

[48] Apart from the slight problem that today it is not possible to produce an outdoor bred campylobacter-free chicken as there always are campylobacter in outdoors productions.

might draw attention towards food risks associated with other products that are not labelled in this way. Hence, we have detected a willingness to pay for food safety and animal welfare under certain conditions, but as these conditions do not completely reflect a real-life shopping situation, the real value may have been overstated.

Today, the price premium for a campylobacter-free chicken is only a few DKK per kg. A comparison with the willingness to pay that was displayed in the survey indicates a great potential for increasing the market for campylobacter-free chickens. Further research into why such a discrepancy exists would be very valuable. For example, an interesting research topic would be how to exploit these opportunities given that labelling of products is also a trade-off between providing enough information on the one side and too much on the other, securing attention from the consumer.

The respondents were asked to assess their next choice of chicken (a marginal valuation task) – all future choices of chicken were not assessed. Therefore, if consumers were to consider the budgetary effects of paying 43 DKK more for not just the next chicken, but all chicken they buy in future, they might want to reduce their consumption of (outdoor-bred campylobacter-free) whole chickens, buy other chicken products or substitute chicken with other types of meat. Therefore, the aggregate market implications can be expected to be lower than the marginal effects.

Another market implication of our results is that the non-linearity of attribute values indicates that there might be niche production opportunities in producing goods with specific *bundles* of characteristics – such as campylobacter-free chicken with improved living conditions. Also, our results indicate that survival of these niche productions might depend on information provision.

A final comment on the market implications of our results is that consumers do not in fact determine demand – the supermarkets do. The demand from consumers has been estimated. However, in modern markets, consumers and producers seldom meet. Producers are represented by producer organisations who coordinate production. Consumers' demand depends on what is available in the shops. Of course, retailers will, to varying degrees, try to satisfy consumer demand – but they also have their own agenda with regard to maximising their own profits. Therefore, consumers willingness to pay has to go through a filter (i.e. preferences at the retail level) before they reach the producers (organisations). Hence, before the market implications of our results can be assessed, knowledge of how consumers' stated behaviour is perceived by retailers/main supermarkets is required.

Policy implications of our results

From a policy point of view, a major difference between food safety and animal welfare is that the externality element in food safety affects public health costs whereas there are no direct expenditures related to animal welfare. Therefore, the public economic interest does not surface in such an outspoken way with respect to animal welfare as with food safety.

There are social costs associated with human infections of campylobacteriosis. Furthermore, consumers have been found to assign value to avoiding campylobacter. These benefits must be weighed against the costs of producing campylobacter-free chickens in order to assess whether there is a positive social value of removing campylobacter risk from chicken.

Our results indicate that there is a market for products with reduced food risks if labels that allow consumers actually to choose campylobacter-free chicken are provided. No welfare gain in providing information about campylobacter was revealed. On the other hand, the results indicate a welfare gain in providing labels with regard to animal welfare and a substantial additional welfare gain in providing animal welfare information was found that supports the labelling[49]. Willingness to pay varied across consumer types, but no systematic differences were found across consumer types in relation to how information affects the willingness to pay. Hence, no advice can be offered with regard to the targeting of information campaigns.

Our results indicate that, given the right circumstances, consumers are willing to pay for food safety and animal welfare. But this is not the only way to secure provision of these attributes. Public authorities can affect the relative prices by issuing taxes on goods associated with food risks and/or subsidies on safe food products. Thereby, the public costs of food risks are internalised and the relative prices make it simpler (relatively cheaper) for consumers to choose a low risk product.

Shortcomings of our study

A few shortcomings of our study can be mentioned which could be improved in future research.

Firstly, the issue of how campylobacter risks were eliminated was not addressed (basically, campylobacter risks can be reduced in primary production through decon-

[49] Provided that labelling and information costs are less than the differences in willingness to pay.

tamination, or later through increased kitchen hygiene). It is, therefore, not known whether the consumer had any particular risk reduction methods in mind when they valued risk reduction. One might expect that risk reduction method is of significance in determining how consumers value risk reduction – this is investigated in an ongoing project[50].

Secondly, information provision was carried out using a before and after evaluation of choice tasks. Information was provided to the same individuals as those who had just completed the first choice task. This might create a conservative measure of the effect of information as individuals might not want to appear inconsistent by changing their behaviour after information has been provided. An alternative approach would be to test attributes with and without information on two different samples. However, in this case, two things would change at the same time (population and information) and adjustments would have to be made for these differences – changes due to information would have to be isolated from changes due to differences in population.

Thirdly, sufficient caution was not exercised in the choice of sample. Hence, our sample is biased with an overrepresentation of high income, residents of the capital city area, etc – these biases indicate that the average willingness to pay values may have been over-estimated.

Generalisation of our results

The mixed results on the effects of expert-based information are not surprising in the light of the general literature on risk perception (Sunstein, 2002; Williams & Hammit, 2001). Of course, the lack of effect from provision of campylobacter information can be attributed to the specific piece of information that was provided (only one type of campylobacter information was tested). It could also be related, however, to the fact that food safety is an attribute with private as well as public good characteristics. The lack of an effect from campylobacter information could indicate that consumers have strong beliefs about factors that affect their own health and that these beliefs are not easily changed. Animal welfare, on the other hand, is a pure public good. The more respondents who knew about the differences between production systems, the more they were willing to pay for improvements. This could indicate that consumers do not have strong prior beliefs about the public good and that their preferences towards

[50] Ongoing research projects funded by the Danish research council are investigating just that (acronyms DECONT and CAMPY, see www.dffe.dk).

public characteristics are more easily affected than their preferences towards private characteristics.

The values of specific amounts of animal welfare and food safety have been estimated – and the effect of a particular type and amount of information provided. It is not suggested that these results are generic, but we believe they are valuable inputs to the food safety and animal welfare debates. Generalisation of results is an important issue in stated preference studies. On one hand, the more specifically the subjects to be valued are defined the easier it is for the respondent to assign a value. On the other hand, the more precisely the subjects are defined, the harder it is to generalise the results.

For example, willingness to pay for free-range egg is a willingness to pay for better living conditions for an egg-laying hen. Carlsson et al. (2003) found a willingness to pay for eggs from free-range versus cage production corresponding to 6-8 DKK for 6 eggs and Bennett (1996) and Bennett & Blaney (2003) found a willingness to pay for animal welfare related to 12 eggs equivalent to 4 - 9 DKK. Similarly, the willingness to pay for an outdoor-bred chicken is a willingness to pay for better living conditions for that particular chicken. Burgess et al. (2004) found a willingness to pay for improved welfare for chickens, laying hens, dairy cows and pigs corresponding to between 20 and 30 DKK per animal. Carlsson et al. (2004b) found a willingness to pay for animal welfare related to the use of mobile abattoirs and the transportation of farm animals to slaughter houses for beef, pigs and chicken productions. Both studies found that willingness to pay for animal welfare depends on the type of animal in question. But how are all these measures related? A reasonable assumption is that consumers would consider animal welfare to be equally important for the egg-laying hen as for the broiler – but one hen can lay many eggs whereas a chicken can only be eaten once – so should the willingness to pay for a free-range egg take into account how many eggs a hen can produce? This is hardly the way the typical consumer values free-range eggs versus free-range broilers.

Similar considerations can be made with respect to food safety. Hayes et al. (1995) found an average willingness to pay for reducing microbiological risks corresponding to 4-5 DKK per sandwich – and they found no distinction between different pathogens with different risk profiles and severity of illness. Furthermore, they found that the willingness to pay increased slightly after information about campylobacter was provided – and that the willingness to pay was not sensitive to the amount of risk reduction. In our study, food safety related to one whole chilled chicken was valued – i.e. a meal for 2-6 people. Does this mean that the willingness to pay for a chicken

should be divided by 2-6 in order to be comparable with the willingness to pay for a chicken sandwich? Probably not, as it is not likely that consumers make these implicit calculations before they value food safety.

A study by Goldberg & Rosen (2005) is of particular interest as they have examined the willingness to pay for reducing salmonella and campylobacter risks. Goldberg & Rosen (2005) investigated the willingness to pay for reducing salmonella and campylobacter in chicken breasts by 0, 40 and 80%. They found willingness to pay estimates ranging from an equivalent of 0 to 50 DKK for various risk reductions using choice experiments and between 10 and 25 DKK using CVM, with the WTP for salmonella being a little higher than for campylobacter.

Goldberg & Rosen (2005) found a nonlinear relation between WTP and risk reduction. For example, the WTP for a given reduction in salmonella as well as campylobacter was smaller than the sum of the WTP for salmonella risk reduction and campylobacter risk reduction individually. They identified this as an embedding effect. Also, Hobbs et al. (2005) found that the willingness to pay for the sum of attributes (food safety, traceability, farm information) was less than the sum of willingness to pay for individual attributes. They interpret this result as showing decreasing marginal willingness to pay for attributes.

Nonlinearity was also revealed in the present survey, but in the opposite direction. The sum of attributes provides an additional utility – not a reduction in utility. The differences in results may be explained by the differences in attributes. In Goldberg & Rosen (2005), the attributes salmonella and campylobacter are indistinguishable to many consumers – so they do not want to pay for the same reduction twice (our survey showed that for 42 % of the respondents stated that previous knowledge about salmonella affected their choices). In the present analysis, the attributes of animal welfare and food safety, on the other hand, represent two very different dimensions of quality and the provision of both leads the consumer to perceive the product as an "all round good". Results from research on consumer behaviour towards organic products indicate that there may be an extra willingness to pay for a product containing a whole range of attributes (Wier et al., 2004).

These examples are mentioned to highlight the difficulties faced when an attempt is made to generalise from the results. Nevertheless, there has been an increasing focus on research in how to transfer benefits (Arrow et al., 1993; Desvousges et al., 1992) The more building bricks that can be provided, the better the overall economic as-

sessment will be – case studies, therefore, provide important input. Further research in how to generalise results would, moreover, be highly valuable.

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Appendix A: The questionnaire

Survey on buying habits, food safety and type of breeding
The survey is part of a research project conducted by researchers at the Institute of Food and Resource Economics, the Royal Veterinary and Agricultural University.

The purpose of the project is partly to gain more insight into consumers' buying habits when purchasing chicken and partly to gain insight into attitudes towards food in general.

There are two different types of chilled chicken at 1300 grams to choose between. Both types are free-range and produced in Denmark. They only differ with regard to type of breeding, campylobacter content and price.

Difference in type of breeding:
The first type of chicken has only been indoors (indoor breeding)
The second type of chicken has also had access to outdoor areas (outdoor breeding)

Difference in the control of campylobacter content:
The first type of chicken is labelled "campylobacter-free". Campylobacter-free chickens are sold in a number of Danish supermarkets today.

The second type of chicken has not been checked for campylobacter content. This means that the campylobacter content is unknown.

Difference in the price for chickens

Other:
Apart from the differences already mentioned, the two types of chicken are identical. The quality, for example, meaning flavour, freshness, shelf-life, nutritional value, etc. are identical for the two types of chicken.

Now imagine that you are in the shop where you usually do your shopping. You wish to buy **one chilled chicken at 1300 grams.**

You have the same amount of money at your disposal that you normally have when you go shopping. Experience from similar surveys shows that some respondents display different behaviour when answering questionnaires than they would in real life

situations. Before ticking the box next to your favoured choice, please imagine yourself in an everyday shopping situation and consider whether or not you are willing to pay the price stated for each of the chicken products.

You will now be presented with 4 independent shopping scenarios. For each shopping scenario please indicate by ticking the appropriate box which of the two types of chicken you would buy. You have a choice between chicken A and B. If you would not buy either of the two types of chicken, please tick the box "none of these".

Shopping scenario 1

Chicken A	**Chicken B**
Outdoor breeding The chicken is not controlled for campylobacter Unit price (DKK) 110	Indoor breeding The chicken is labelled "campylobacter-free" Unit price (DKK) 47

I choose (tick one box only)

A	**B**	**None of these**

Q.2 Did you find it difficult to choose between the chicken products and/or did you for any of the above shopping scenarios choose the option "None of these"?
(Tick one box only)

(1) ❑ Yes I found it difficult, but did not choose "None of these" (Go to Q3)
(2) ❑ Yes I found it difficult and chose "None of these" (Go to Q3)
(3) ❑ No I did not find it difficult, but chose "None of these" (Go to Q3)
(4) ❑ No I did not find it difficult and did not choose "None of these" (Go to Q4)
(5) ❑ Do not know (Go to Q4)

Q.3 What was your main reason for finding the choice task difficult to make and/or why did you choose the option "None of these"?
(Tick one box only).

(1) ❑ I could not relate to the information
(2) ❑ I do not know what campylobacter is
(3) ❑ There was not sufficient information for me to be able to make a choice
(4) ❑ I do not buy chicken meat
(5) ❑ I thought the chickens were too expensive
(6) ❑ I normally buy other chicken products than whole chilled chickens
(7) ❑ I did not understand the questions
(8) ❑ I was not able to rank the priorities campylobacter content, type of breeding and price
(9) ❑ I did not find the options realistic
(10) ❑ I support outdoor breeding chickens, but do not believe that I, the consumer, should carry the cost
(11) ❑ I support campylobacter -free chickens, but do not believe that I, the consumer, should carry the cost
(12) ❑ Do not know

Q.4 How certain are you about your choices in the above shopping scenarios? On a scale of 1-7, where 1 is very uncertain and 7 is very certain; please indicate your degree of certainty

(1) ❑ 1 - **Very uncertain**
(2) ❑ 2 – Fairly uncertain

(3) ❑ 3 – A little uncertain
(4) ❑ 4 – Neither certain nor uncertain
(5) ❑ 5 – A little certain
(6) ❑ 6 – Fairly certain
(7) ❑ 7 **Very certain**
(8) ❑ Do not know

Q. 5 To which of the following characteristics did you attach the greatest importance in the above shopping scenarios?
(Tick one box only)

(1) ❑ Type of breeding
(2) ❑ Campylobacter content
(3) ❑ Price
(4) ❑ I was not able to make a choice
(5) ❑ Do not know

Q.6 Please indicate the degree to which the following statements represent your considerations when going shopping for yourself and possibly for your family. Please use a scale of 1 – 5, where 1 is completely agree and 5 is completely disagree.

	1 - Completely agree	**2 - Agree**	**3 - Neutral**	**4 - Disagree**	**5 - Completely disagree**	**Do not know**
It is important that the price is low	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
It is important that the product is organic	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
It is important that the product is low-fat	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
The type of breeding used is important	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑

	1 - Completely agree	2 - Agree	3 - Neu-tral	4 - Dis-agree	5 - Com-pletely dis-agree	Do not know
It is important that the product appears tempting	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
It is important that the product is campylobacter-free	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
It is important that the product is produced in Denmark	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
It is important that the product is of good quality	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑

Q.7 Do you believe it possible to avoid campylobacter by maintaining good hygiene basics in the kitchen and by using correct food preparation practices?

(1) ❑ Yes
(2) ❑ No
(3) ❑ Do not know

Q.8 Do you think that your household maintains good hygiene basics in the kitchen?

(1) ❑ Yes
(2) ❑ No
(3) ❑ Do not know

[Sample A is given information about campylobacter]
Again you have to choose between two different chicken products that differ with regard to type of breeding, campylobacter content and price.

However, this time you will also be given some information about the **campylobacter bacteria**. The information has been documented by The Danish Institute for Food and Veterinary Research.

Campylobacter. Today, the campylobacter bacteria, especially found in poultry, are the most common cause of food poisoning. If you are infected with campylobacter, the following clinical picture may occur:

Typical symptoms
- general feeling of discomfort
- severe diarrhoea
- stomach ache
- vomiting
- fever

After-effects
- In rare cases, nerve damage may occur, causing temporary paralysis

Permanent damage (may occur in rare cases)
- arthritis
- irritable bowel syndrome
- chronic diarrhoea

Your risk of infection
If you choose a chicken product that has not been controlled for campylobacter content, your risk of campylobacter infection is 1 in 1000, or 0.1 per cent. If you choose a chicken labelled “campylobacter-free”, your risk of infection is 0.

What you can do
By taking sensible precautions in the kitchen, you will be able to avoid infection from campylobacter infected chickens. Campylobacter bacteria die when frozen or heat treated at more than 75°C.
It is important:
to keep raw and prepared food separate
to wash hands, tools and cutting board thoroughly after contact with the meet
to prepare the meat thoroughly either by frying or boiling and keep it refrigerated
not to use the same tools for chilled and cooked meat.

If you believe your standard of kitchen hygiene and food preparation to be just as good as the abovementioned recommendations, the risk of infection will be heavily reduced.

Apart from the differences in type of breeding, campylobacter content and price mentioned above, the two types of chicken are identical. The quality, for example, meaning flavour, freshness, shelf-life, nutritional value etc. is identical for the two types of chicken.

[Sample B is given information about breeding methods]
Again you have to choose between to different chicken products that differ with regard to type of breeding, campylobacter content and price.

However, this time you will also be given some information about the **type of breeding**. The information has been documented by the Ministry of Food, Agriculture and Fisheries

Indoor breeding
- The chickens are kept indoors al the time
- Each chicken has less space than an A4 sheet
- The light is kept on almost all the time day and night. This means that they eat most of the time and thus grow faster
- It is not possible for the chickens to dust bathe
- The life span of the chickens is approx. 6 weeks

Outdoor breeding
- The chickens also have access to outdoor areas
-Each chicken has almost two A4 sheets indoors. Furthermore, each chicken has a living space of 4 square metres
- The circadian cycle of the chickens is based on daylight. The chickens thus grow at a normal speed
- It is possible for the chickens to dust bathe
- The life span is approx. 12 weeks

Now imagine that you are in the shop where you usually do your shopping. You wish to buy **one chilled chicken at 1300 grams.**

You have the same amount of money at your disposal that you normally have when you go shopping. Before ticking the box next to your favoured choice, please imagine yourself in an everyday shopping situation and consider whether or not you are willing to pay the price stated for each of the chicken products.

You will now be presented with 4 independent shopping scenarios. For each shopping scenario please indicate by ticking the appropriate box which of the two types of chicken you would buy.

You have a choice between chicken A and B. If you would not buy either of the two types of chicken, please tick the box "none of these".

Apart from the differences in type of breeding, campylobacter content and price mentioned above, the two types of chicken are identical. The quality, for example, meaning flavour, freshness, shelf-life, nutritional value etc. is identical for the two types of chicken.

[Below, we provide an example of a choice set (each respondent receives 4 choice sets)]

Q.9 Shopping scenario 1

Chicken A	**Chicken B**
Outdoor breeding	Indoor breeding
The chicken is labelled "campylobacter-free"	The campylobacter content of the chicken has not been checked
Unit price (DKK) 97	Unit price (DKK) 64

I choose (tick one box only)

A	**B**	**None of these**

Q.10 Did you find it difficult to choose between the chicken products and/or did you for any of the above shopping scenarios choose the option "None of these"?
(Tick one box only)

(1) ❑ Yes I found it difficult, but did not choose "None of these" (Go to Q3)
(2) ❑ Yes I found it difficult and chose "None of these" (Go to Q3)

(3) ❑ No I did not find it difficult, but chose "None of these" (Go to Q3)
(4) ❑ No I did not find it difficult and did not choose "None of these" (Go to Q4)
(5) ❑ Do not know (Go to Q4)

Q.11 What was your main reason for finding the choice task difficult to make and/or why did you choose the option "None of these"?
(Tick one box only).

(1) ❑ I could not relate to the information
(2) ❑ I do not know what campylobacter is
(3) ❑ There was not sufficient information for me to be able to make a choice
(4) ❑ I do not buy chicken meat
(5) ❑ I thought the chickens were too expensive
(6) ❑ I normally buy other chicken products than whole chilled chickens
(7) ❑ I did not understand the questions
(8) ❑ I was not able to rank the priorities campylobacter content, type of breeding and price
(9) ❑ I did not find the options realistic
(10) ❑ I support outdoor breeding chickens, but do not believe that I, the consumer, should carry the cost
(11) ❑ I support campylobacter-free chickens, but do not believe that I, the consumer, should carry the cost
(12) ❑ Do not know

Q.12 How certain are you about your choices in the above shopping scenarios? On a scale of 1-7, where 1 is very uncertain and 7 is very certain; please indicate your degree of certainty

(1) ❑ 1 - **Very uncertain**
(2) ❑ 2 – Fairly uncertain
(3) ❑ 3 – A little uncertain
(4) ❑ 4 – Neither certain nor uncertain
(5) ❑ 5 – A little certain
(6) ❑ 6 – Fairly certain
(7) ❑ 7 **Very certain**

(8) ❑ Do not know

Q.13 To which of the following characteristics did you attach the greatest importance in the above shopping scenarios?

(Tick one box only)

(1) ❑ Type of breeding
(2) ❑ Campylobacter content
(3) ❑ Price
(4) ❑ I was not able to make a choice
(5) ❑ Do not know

Q.14 Please indicate by ticking the appropriate box whether or not you agree with the following statements

(Tick one box only)

	Agree	Disagree	Do not know
The welfare of outdoor-bred chickens is better than that of indoor-bred chickens	(1) ❑	(2) ❑	(3) ❑
Outdoor-bred chickens are more likely to be infected with campylobacter than are indoor-bred chickens	(1) ❑	(2) ❑	(3) ❑

Q.15 Please consider the following statements about health and type of breeding. On a scale of 1-5, where 1 is completely agree and 5 is completely disagree, please indicate your degree of agreement

	1 - Completely agree	2 - Agree	3 - Neutral	4 - Disagree	5- Completely disagree	Do not know
I think there is too much hysteria surrounding the animal welfare issue	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I support animal welfare through my choice in food products	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑

	1 - Completely agree	2 - Agree	3 - Neutral	4 - Disagree	5- Completely disagree	Do not know
I think that outdoor-bred chickens taste better than indoor-bred chickens	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
Although infection by campylobacter can be prevented through maintaining good hygiene basics and correct food preparation practices, I do not want to have campylobacter bacteria in my kitchen	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I think there is too much hysteria surrounding the campylobacter issue	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I believe that the producers are responsible for supplying food products that carry no health risks for the consumers	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
If the authorities could ensure reliable marking, I would be happy to pay extra for campylobacter-free chicken	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
If the authorities could ensure reliable marking, I would be happy to pay extra for increased animal welfare	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I believe that the authorities are responsible for carrying the costs of ensuring campylobacter-free chicken meat.	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I believe that the authorities are responsible for carrying the costs of increased animal welfare	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I believe that eating Danish food products carries no health risks	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑

Q.16 Please consider the following statements about information on food products. On a scale of 1-5, where 1 is completely agree and 5 is completely disagree, please indicate your degree of agreement

	1 - Completely agree	2 - Agree	3 - Neutral	4 - Disagree	5- Completely disagree	Do not know
I have sufficient information when I buy food products	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I have confidence in the information supplied by the Danish Institute for Food and Veterinary Research	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I have confidence in the product information supplied by the producers	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I have confidence in the Ø-label (a label that shows that the article is an organic product produced under control of the Danish authorities)	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I have confidence in the information supplied by the Ministry of Food, Agriculture and Fisheries	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I have confidence in the information supplied by the Danish Consumer Council, e.g. through the independent consumer magazine "Tænk"	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑
I have confidence in the informative labeling of consumer goods	(1) ❑	(2) ❑	(3) ❑	(4) ❑	(5) ❑	(6) ❑

Q.17 Prior to this survey, had you heard about campylobacter?

(1) ❑ Yes

(2) ❑ No

(3) ❑ Do not know

Q.18 Prior to this survey had you heard about salmonella?

(1) ❑ Yes

(2) ❑ No (Go to Q24)

(3) ❑ Do not know

Q.19 Have your knowledge of salmonella influenced your responses in this questionnaire?

(1) ❑ Yes

(2) ❑ No

(3) ❑ Do not know

Q.20 Are you at an increased risk of infection by campylobacter due to diminished health?

(1) ❑ Yes

(2) ❑ No

(3) ❑ Do not know

Q.21 Have you or anyone you know of ever been ill from campylobacter?

(1) ❑ Yes

(2) ❑ No

(3) ❑ Do not know

Q.22a What kind of chicken meat product do you usually buy? (Please tick one box in each line)

Organic chicken ❑ Non-organic chicken ❑ Do not know ❑

Q.22b

Chicken labelled campylobacter-free ❑ Chicken not labelled campylobacter-free ❑ Do not know ❑

Q.23 What is the approximate price you usually pay for a chicken?

Less than 40 DKK ❑
40 DKK ❑
47 DKK ❑
55 DKK ❑
64 DKK ❑
74 DKK ❑
85 DKK ❑
97 DKK ❑
110 DKK ❑
More than 110 DKK ❑
Do not know ❑

Q.24 During the past 10 years, have you been a member of an organisation due to its aim to protect animal welfare?

(1) ❑ Yes
(2) ❑ No
(3) ❑ Do not know

Q.25 Are you employed?

1. in a private company
2. in a public institution
3. Selfemployed
4. Not employed
5. Do not know

This is the end of the questionnaire – thank you for your help

[Furthermore, the following pre-data are available from ACNielsen]

Q1: Gender
Q2: Year of birth
Q4: Number of people in the household
Q5: Number of children under the age of 15 in the household
Q6: Marital status
Q7: Highest level of school related education obtained
Q8: Highest level above school related education obtained (Basic vocational training, ONC (Ordinary National Certificate) level education, HNC (Higher National Certificate) level education, Bachelor's level of education, Master's or higher level of education, Other, None)
Q12: Total household income before tax
Q13: Is it primarily you, who does the shopping in your household
Q16: What kind of housing do you live in?
Q19: What is your postal code?

Appendix B: Literature review - Experiences from stated preference surveys of food safety and animal welfare

In the vast amount of literature on economic valuation, we have identified studies concerning animal welfare and food safety, but few where the value of both attributes are estimated. The methods used to estimate willingness to pay for animal welfare and food safety include contingent valuation, contingent ranking, price auctions and choice experiments. We present these studies below in section B1. An overview over the studies is provided in table B1 (studies using and discussing choice experiments), Table B2 (studies using CE on food safety and animal welfare), and Table B3 (studies using revealed valuation methods other than CE on food safety and animal welfare).

B1. Willingness to pay studies of animal welfare and food safety

Animal welfare using CE

Carlsson et al (2003) carried out CE on animal welfare, where WTP for free-rangefree-range production of table eggs versus battery cage production was estimated. The willingness to pay estimates for free-rangefree-range production was estimated to 10 SEK. Furthermore Carlsson et al. (2004a) complete a CE survey on animal welfare in relation to the transportation of farm animals to slaughterhouses versus the use of mobile abattoirs. The results indicate that consumers are willing to pay a premium for mobile abattoirs for beef and pigs but place a negative monetary value on mobile abattoirs in chicken production. The importance of animal welfare as a product quality attribute seems to be animal specific. The WTP for mobile abattoirs was between -3.15 SEK and 4.18 SEK dependent on the type of animal.

Animal welfare using CVM

Burgess et al. (2004) valued consumers' preference structure for improved animal welfare using two different methods; double bounded CVM and paired comparisons. They concluded that there is a WTP for improved welfare for chicken, laying hens, dairy cows and pigs. Furthermore, consumers make largely rational choices over alternative farm animal welfare enhancing scheme, and the results are not sensitive to the elicitation method. Bennett (1996) used CVM to analyse consumers' WTP for increased animal welfare in egg production. He finds that the main aspects of livestock production that people are concerned about, are (listed in decreasing order); housing and confined living conditions, feed and medicine, livestock transport and livestock markets and then slaughtering process. Bennett (op cit) concludes that there is a significant WTP to pay for increased animal welfare in Great Britain. Bennet & Blaney

(2003) use CVM to further elicit WTP for supporting legislation to phase out the use of battery cages for egg production in the European Union. They conclude that the estimated benefits of phasing out the use of battery cages outweigh the estimated annual costs over a 12-year period.

Food safety risk using CE and CVM

Goldberg & Roosen (2005) used personal interview in local stores to perform CE. Information on symptoms, incidence rates and associated foods were given to the respondents prior to the choice tasks. Three attributes are included: risk reduction of salmonellosis, risk reduction of campylobacteriosis and price. Each attribute can obtain three levels of health risk (current level which is 76 out of 100.000 for salmonella and 58 out of 100.000 for campylobacter[51], 40% reduction, 80% reduction) and three price levels (10, 11 and 12 Euro/kg) Each questionnaire includes 8 choice sets (a choice set consists of choosing between alternatives A and B and an opt-out) and 3 contingent valuation tasks – there are 6 blocks/sub samples. They find a positive WTP for risk reduction of both salmonellosis and campylobacteriosis of around 1.3 Euro for 40% risk reduction and 2 Euro for 80% risk reduction. The WTP is a little higher for salmonella than for campylobacter and a nonlinear relation between WTP and risk reduction is found. In example, the WTP for a given reduction in salmonella as well as campylobacter is smaller than the sum of the WTP for salmonella risk reduction and campylobacter risk reduction individually (this applies for 40% as well as for 80%).

Food safety and the effect of information using experimental auctions

Hayes e*t al.* (1995) valued food safety in relation to food borne illness. This study is particularly interesting in the present context because the attributes are very similar to the survey we have done (cf. chapter 8 to 12). By use of experimental auction markets (auction for sandwiches) they evaluated the willingness to pay for safer food in relation to five different pathogens like salmonella, campylobacter, staphylococcus aureus, trichinella spiralis and clostridium perfringens. The respondents were given a test sandwich with unspecified risk of getting ill (a 'normal' sandwich). The respondents were then offered an auction where they could buy stringently screened sandwiches with a risk of 1 in 100 million chance of suffering from the pathogen in question from eating the sandwich. Hayes et al. (1995) conclude that the consumers underestimate rather than overestimate the risk of food borne illness. They explain the results partly by the composition of respondents which were young adults whose ten-

[51] Based on number of registered human infections.

dencies to underestimate risk are often apparent in their behaviour. And partly as a consequence of respondents lacking knowledge of the nature of food borne illness since infections from food borne pathogens typically displays symptoms similar to those of the flu which is why individuals do not realize they are suffering from a food borne pathogen rather than the flu. They also find that the pathogen specific values seem to act as surrogates for general food safety preferences. Further, the values of risk reduction were relatively stable across a wide range of risks indicating that respondents rely on prior beliefs about risks.

Finally, the respondents were given information about the risk of the sandwiches in terms of the probability and severity and asked to bid again. The information about the 'normal' sandwich was described as follow: "*If you eat this food, there is a 1 in 125.143 change that you will become ill from campylobacter"*. And, the information about the screened sandwich was: "*This food has been subjected to stringent screening for campylobacter. There is 1 in 100.000.000 change of getting campylobacteriosis from consuming this food"*. Both products were further described by the symptoms of illness: "*Symptoms are those of an intestinal disease with acute diarrhoea and severe abdominal pains. Diarrhoea is preceded by brief fever and malaise. The actual individual chance of infection of campylobacteriosis is 1 in 114 annually. Of those individuals who get sick, 1 individual out of 1000 will die annually. The average cost for medical expenses and productivity losses from a mild case of campylobacteriosis is $230"*. Further, they analyse how consumers respond to changes in the risk of illness for one of the pathogens, salmonella. The response to a change in risk of illness from salmonella was evaluated by repeated auctions where the Salmonella risk was repeatedly decreased with a factor 10 from (1 in 13.7) to (1 in 1370000). Hayes et al. (1995) found that ínformation about the risk only increased the willingness to pay estimate slightly.

Food related health risk of GMO's using CE and CR

Hu et al. (2004) evaluated consumers' tradeoffs between unknown risks on health and the environment (perceived risks associated with GM food) and perceived benefit associated with GM food such as richness of healthy vitamins and environmentally friendly production process. Initially in the survey, the respondent was asked to identify their preferred bread types. In the choice sets, respondents are choosing between their preferred bread types, a bread product with some new features and an opt-out alternative (none of the two bread types). Hu et al. (2004) concluded that there is considerable diversity amongst consumers in risk attitudes towards GM food and willingness to trade off between risk and benefits depending on respondents' personal

characteristics such as gender, number of children in the household, education and age. The same idea of identifying *consumers individual status quo choice* by first eliciting the respondent's own preferred brand and then use this as the individual baseline choice, is used in Kontoleon & Yabe (2003) on GM foods.

Genetically modified goods and the GM market have been analysed in several other CE surveys. Burton et al. (2004) evaluate consumers' preferences regarding labelling of GM foods. Also, Carlsson et al. (2004c) analyse consumers WTP for labels and bans on using GM in animal fodder. The results show that consumers WTP is significantly higher to ensure a total ban on the use of GM in animal fodder than for labelling. For other studies on GM food, see James et al. (2003) and Kontoleon & Yabe (2003).

Bjørner et al. (2004) estimated WTP for biodiversity, health and uncertainty in a CR study as effects on a decrease in the use of pesticides by the agricultural sector. As an indicator for the attribute biodiversity they use the population of birds in the arable land, while allergy is used as the health attribute. This health attribute entails long term effects as compared to the effects in the present study on pathogen infections that mainly cause short term effects. Among other results, Bjørner et al (op cit) included an uncertainty interval around the expected change in number of allergy cases, and find that uncertainty about the effect on allergy increases the WTP for the health attribute by up to 21-53% as compared to the WTP estimates for changes in the health attribute without explicit mentioning of uncertainty.

Food safety using experimental auction

Canadians WTP for traceability, food safety and on farm production information for beef (and ham) sandwiches are elicited using experimental auctions in Hobbs (2002). The attributes are valued individually and together. She finds that a WTP for improved food safety (unspecified) is 15-20% of the price of a base sandwich. Further, the willingness to pay for a sandwich including all attributes is less than the sum of the willingness to pay for the individual attributes which is argued to indicate a decreasing marginal willingness to pay for attributes.

Hobbs (2005) also finds that, in Canada, information from federal government is the most trusted followed by information from an independent quality assurance firm whereas information from environmental and animal welfare groups as well as from processors and retailers was the least trusted.

Table B1. Studies using and discussing choice experiment

Author	No. of CS and blocks	No. of alternatives	No. of attributes and levels	Econometric model
Adamowicz, W.; Louviere, J. & M. Williams (1994): Combining revealed and stated preference methods for valuing environmental amenities	64 CS, 4 blocks	3 alternatives per CS	13 attributes described by 2-4 levels	Multinomial logit
Adamowicz, W.; Swait, J.; Boxall, P.; Louviere, J. & M. Williams (1997): Perceptions versus Objective Measures of Environmental Quality in Combined Revealed and Stated Preference Models of Environmental Valuation	32 CS, 2 blocks	3 alternatives per CS	6 attributes described by 2-4 levels	Conditional logit
Alfnes, F & K. Rickertsen (2004): Risk aversion in the consumer food market: an experimental study of consumer attitudes toward beef tenderness labelling	-	-	-	-
Alpizar, F.; Carlsson, F. & P. Martinsson (2003): Using choice experiments for non-market valuation	-	-	-	-
Anderson, D. A. & J. B. Wiley (1992): Efficient Choice Set Designs for Estimating Availability Cross-Effects Models	-	-	-	-
Anderson, S. P. & A de Palma (1991): Multi product firms: A nested logit approach	-	-	-	Nested logit
Banzhaf, M.; Johnson, F. R. & K. E. Mathews (2001) : Opt-out alternatives and anglers stated preferences	-	-	-	Conditional logit and Random Parameter logit
Bateman, I. J; Carson, R. T.; Day, B.; Haneman, M.; Hanley, N.; Hett, T.; Jones-Lee, M.; Loomes, G.; Mourato, S.; Ôzdemiroglu, E.; Pearce, D.; Sugden, J. & J. Swanson (2002): Economic valuation with stated preference techniques, a manual	-	3 alternatives per CS	7 attributes described by 3-6 levels	Multinomial logit and conditional logit
Batsell, R. R. & J. J. Louviere (1991): Experimental analysis of choice	-	-	-	-
Bech, M.; Sørensen, J. & J. Lauridsen (2005): Eliciting women's preferences for a training program in breast self-examination: a conjoint ranking experiment.	18 CS per respondent	2 alternatives per CS	4 attributes described by 2-3 levels	Ordered logit
Bech, M.; Kjær, T., Lauridsen, J. & D. Gyrd-Hansen (2004): Hvad ønsker studerende af deres fremtidige job? Illustration af et diskret valg eksperiment	-	-	-	Random Effect probit

Bennett, J. & V. Adamowicz (2001): Some fundamentals of environmental choice modelling	-	-	-	-
Bierlaire, M. (2001): A theoretical analysis of the cross-nested logit model	-	-	-	Cross Nested logit
Blamey, R.; Louivere, J. J. & J. Bennett (2001): Choice set design	-	-	-	-
Boxall, P. C.; Englin, J. & W. L. Adamowicz (2003): Valuing aboriginal artefacts: a combined revealed-stated preference approach	-	-	-	Conditional logit and Mixed logit
Boyle, K. J.; Holmes, T. P.; Teisl, M. F. & B. Roe (2001): A Comparison of Conjoint Analysis Response Formats	-	-	7 attributes described by 2-3 levels	Ordered probit, rank-ordered logit and tobit
Brownstone, D. & K. Train (1999): Forecasting new product penetration with flexible substitution patterns	-	3 alternatives per CS	14 attributes described by 4 levels	Probit and mixed logit
Burton, M.; Rigby, D. & T. Young (2004): UK consumers, regulation and the market for GM food.	-	-	4 attributes described by 3-7 lveles	Mixed logit
Carlsson, F.; Frykblom, P. & C. Liljenstolpe (2003b): Valuing wetland attributes: an application of choice experiments	60 CS, 15 blocks. 4 CS per respondent	3 alternatives per CS	7 attributes described by 2-4 levels	Random parameter logit
Carlsson, F.; Frykblom, P. & C-J. Lagerkvist (2004c): Using cheap-talk as a test of validity in choice experiments	-	-	-	Random parameter logit
Carlsson, F. & P. Martinsson (2003): Design techniques for stated preference methods in health economics	-	-	-	-
Carson, R. T.; Louviere, J. J.; Anderson, D. A.; Arabie, P.; Bunch, D.; Hensher, D. A.; Johnson, R. M.; Kuhfeld, W. F.; Steinberg, D.; Swait, J.; Timmermans, H. & J. B. Wiley (1994): Experimental analysis of choice	-	-	-	-
Carson, R.; Flores, N. & N. Meade (2001): Contingent valuation: controversies and evidence	-	-	-	-
Caussade, S.; Ortúzar, J. de. O.; Rizzi, L. I. & D. A. Hensher (2005): Assessing the influence of design dimensions on stated choice experiment estimates	6 – 15 per respondent	3 – 5 alternatives per choice set	3 - 6 attributes described by 2 – 4 levels	Multinomial logit and heteroskedastic logit
Cummings, R. G. & L. O. Taylor (1999) : Unbiased value estimates for environmental goods: a cheap talk design for the contingent valuation method	-	-	-	Probit
DeShazo, J. R.; Cameron, T. A. &	-	-	-	-

M. Saenz (2004): A test of choice set misspecification applicable to stated preference methods				
Foster, V. & S. Mourato (2002): Testing for consistency in contingent ranking experiments	3 CS	4 alternatives per CS	-	Conditional logit and rank-ordered logit
Garrod, G & G. Willis (1999): Economic valuation of the environment. Methods and case studies	-	-	-	-
Gyrd-Hansen, D. & J. Søgaard (2001): Analysing public preferences for cancer screening programmes		4 alternatives per CS	4 attributes described by 5-6 levels	-
Haaijer, R.; Kamakura, W. & M. Wedel (2001): The 'no-choice' alternative in conjoint choice experiments	-	-	-	Conditional logit and nested logit
Hanley, N. ; Mourato, S. & R. E. Wright (2001): Choice modelling approaches: A superior alternative for environmental valuation?	-	-	-	-
Hanley, N.; Wright, R. E. & G. Koop (2002): Modelling recreation demand using choice experiments: climbing in Scotland	-	3 alternatives per CS	6 attributes described by 2-6 levels	Nested logit and multinomial logit
Hensher, D.; Louivere,J. & J. Swait (1999): Combining sources of preference data	80 CS, 5 blocks	-	18 attributes described by 2-8 levels	Multinomial logit
Hensher, D. A. & A. J. Reyes (2000): Trip chaining as a barrier to the propensity to use public transport	-	-	-	Mixed logit, multinomial logit and nested logit
Heiss, F. (2002): Specification(s) of nested logit models	-	-	-	Nested logit
Huber, J. & K. Zwerina (1996): The importance of utility balance in efficient choice designs	-	-	-	-
Hunt, G. L. (2000): Alternative nested logit model structures and the special case of partial degeneracy	-	-	-	Nested logit
Kontoleon, A. & M. Yabe (2003): Assessing the impacts of alternative 'opt-out' formats in choice experiment studies: Consumer preferences for genetically modified content and production information in food	-	-	-	Random parameter logit
Kuhfeld, W. F. (2004): Marketing research. Methods in SAS	-	-	-	-
Lancsar, E. & E. Savage (2003): Deriving welfare measures from discrete choice experiments: inconsistency between current methods and random utility and welfare theory	-	-	-	Multinomial logit
Louivere, J. J (2001): Choice experiments: An overview of concepts and issues	-	-	-	-

Louivere, J. J.; Hensher, D. A. & J. D. Swait (2000): Stated choice methods analysis and applications	-	-	-	-
McIntosh, E. & M. Ryan (2002): Using discrete choice experiments to derive welfare estimates for the provision of elective surgery: Implications of discontinuous preferences	-	2 alternatives per CS	3 attributes described by 2-4 levels	-
Paulrod, A. & T. Laitila (2004): Valuation of management policies for sport-fishing on Swedens Kaitum river	20 CS, 5 blocks. 4 CS per respondent	-	9 attributes described by 3 levels	-
Rowe, R. D; Schulze, W. D. & W. S. Breffle (1996): A test for payment card biases	-	-	-	-
Ruby, M. C.; Johnson, F. R. & K. E. Mathews (1998): Just say no: Opt-out alternatives and anglers stated preferences	30 Cs, 2 blocks	3 alternatives per CS	7 attributes described by 2-6 levels	Random parameter logit and conditional logit
Ryan, M. & F. S. Miguel (2003): Revisiting the axiom of completeness in health care	-	-	12 attributes described by 2-3 levels	-
Ryan, M. & D. Skåtum (2004): Modelling non-demanders in choice experiments	-	3 alternatives per CS	6 attributes described by 3-8 levels	Multinomial logit and nested logit
Ryan, M. & S. Wordsworth (2000): Sensitivity of willingness to pay estimates to the level of attributes in discrete choice experiments	13 CS, 2 blocks. 6 or 7 CS per respondent	3 alternatives per CS	6 attributes described by 3-4 levels	Random effect probit
Schwabe, K. A.; Schumann, P. W.; Boyd, R. & K. Doroodian (2001): The value of changes in deer season length: an application of the nested multinomial logit model	-	-	-	Nested logit
Scott, A. (2002): Identifying and analysing dominant preferences in discrete choice experiments: An application in health care	-	2 alternatives per CS	4 attributes described by 2-4 levels	-
Swait, J. & J. Louviere (1993): The Role of the Scale Parameter in the Estimation and Comparison of Multinomial Logit Models	-	-	-	Multinomial logit
Train, K. (1998): Recreation demand models with taste differences over people	-	-	8 attributes	Random parameter logit and conditional logit
Verboven, F. (1996): The nested logit model and representative consumer theory	-	-	-	Nested logit
Wen, C-H. & F. S. Koppelman (2000): The generalized logit model	-	-	-	Nested logit

Table B2. Studies using CE on food safety and animal welfare

Author	No. of CS and blocks	No. of alternatives	No. of attributes and levels	WTP estimate	Econometric model
Stated preference method – choice experiment					
Bennett, R. (1995): The value of farm animal welfare	-	-	-	-	-
Burton, M.; Rigby, D. & T. Young (2004): UK consumers, regulation and the market for GM food.	-	3 per CS	4 attributes described by 3-8 levels Status quo as opt out	-	Mixed logit
Carlsson, F.; Frykblom, P. & C. J. Lagerkvist (2003): Farm animal welfare – testing for a market failure.	-	3 per CS	4 attributes described by 2-3 levels	8-10 SEK for 6 eggs from free-range hens[52]	Random parameter logit (mixed logit)
Carlsson, F.; Frykblom, P. & C-J. Lagerkvist (2004a): Consumer benefits of labels and bans on genetically modified food – An empirical analysis using choice experiments	-	2 per CS	8 attributes described by 2-5 levels No opt out	5-20 SEK for chicken meat not genetically modified and 3-8 for eggs not genetically modified[53]	Random parameter logit (mixed logit)
Carlsson, F.; Frykblom, P. & C. J. Lagerkvist (2004b): Consumer willingness to pay for farm animal welfare – transportation of farm animals to slaughter versus the use of mobile abattoirs.	-	2 per CS	7 attributes described by 2-3 levels	-3.15-4.18 SEK for use of mobile slaughter houses[54]	Random parameter logit (mixed logit)
Goldberg, I. & Roosen, J (2005): Measuring consumer willingness to pay for a health risk reduction of salmonellosis and campylobacteriosis	8 CS and 3 CVM	-	3 attributes described by 3 levels	1.3-2 euro for reducing campylobacter and salmonella in chicken breasts	Conditional logit and dichotomous choices

Hu, W.; Hünnemeyer, A.; Veeman, M.; Adamwicz, V. & L. Srivastava (2004): Trading off health, environmental and genetic modification attributes in food	32 divided into 4 blocks, 8 CS per respondent	-	4 attributes described by 2-4 levels	-2.46—1.66 $ for GM modified products, -0.25-1.39 $ for the health attribute and -1.49-1.88 $ for the environmental attribute[55].	Conditional logit
James, S. & M. Burton (2003): Consumer preferences for GM food and other attributes of the food system	28 CS divided into 3 blocks	3 per CS	6 attributes described by 3-11 levels	12-22 $ per week[56]	Conditional logit
Kontoleon, A. & M. Yabe (2003): Assessing the impacts alternative 'opt-out' formats in choice experiment studies – Consumer preferences for genetically modified content and production information in food	-	-	-	-	Random parameter logit (Mixed logit)

Table B3. Studies using revealed valuation methods other than CE on food safety and animal welfare

Author	Method	WTP estimate
Revealed preference methods		
Alm, K. (2004): In what way is consumers' definition of animal welfare related to the consumption?		-
Bennett, R. M. (1996): Willingness-to-pay measures of public support for farm animal legislation	CVM, dichotomous choice	0.43£ for 12 eggs when cages is banned[57]
Bennett, R. M. & R. J. P. Blaney (2003): Estimation benefits of farm animal welfare legislation using the contingent valuation method	CVM	0.90£ per dozen eggs and median WTP at 0.45£[58]
Bjørner, T. B.; Hauch, J. & S. Jespersen (2004): Biodiversity, health and uncertainty – a contingent ranking study	Contingent ranking	213-203 DKK per household for a one percent increase in the population of birds. Positive willingness to pay for a reduction in allergy cases.
Burgess, D.; Hutchinson, W. G.; McCallion, T. & Scarpa, R. (2004): Choice rationality in stated preference methods applied to farm animal welfare improvements	CVM, paired comparisons	2.1-2.95 £[59] for an animal welfare improvement
Hamilton, S. F.; Sunding, D. L. & D. Zilberman (2003): Public goods and the value of product quality regulations: the case of food safety	CVM, in person surveys and voting behaviour	??
Hayes, D. J.; Shogren, J. F.; Shin, S. Y. & J. B. Kliebenstein (1995): Valuing food safety in experimental auction markets	Experimental auction market integrated information provision	0.30-0.70 $ per meal for reducing microbiological risks – WTP increases slightly after information about campylobacter. WTP is not sensitive to amount of risk reduction,
Hayes, D. J.; Fox, J. A. & J. F. Shogren (2002): Experts and activists: how information affects the demand for food irradiation	Second price auction	-
Rozan, A.; Stinger, A. & M. Willinger (2004): Willingness to pay for food safety: an experimental investigation of quality certification on bidding behaviour	Second price auction, Becker-DeGroot-Marschak procedure	-

B2. The effect of expert based information on consumers' WTP for food safety and animal welfare

There is a lot of literature on the topics risk perception, information, and consumer behaviour, and we will not go into the large field of qualitative, sociological studies on risk perception here. However, some of these studies points out some important results regarding information provision and risk perception, indicating that public authorities play a key role in information provision regarding credence goods, as public information is generally trusted (Nayga et al., 2002; Banerjee and Solomon, 2003, Hobbs, 2005). For issues subject to public concern, the government may have an incentive to provide information to consumers by e.g. financing information campaigns, consumer education, promoting and certifying labels, etc. Information such as *expert advice based on scientific risk assessment* is central in this regard. Sunstein (2002) and Williams & Hammitt (2001) suggest a disparity between consumer risk perception and scientific risk assessment and points at a need for improving the understanding of how consumers create their risk perception, to what extent it is influenced by expert-based information provision and how risk perception affects actual demand. Uncertainty with respect of food quality and safety hinders consumers attempt to match food choices with preferences, and food quality and safety issues have received intensive mass media coverage in the recent years. This has led consumers and agri-food chain stake holders to change their beliefs, attitudes and behaviour. There has also been a growing interest, not only in the role and mechanisms of information, but also in the evaluation of the various techniques and vehicles for spreading information. Much effort has been devoted to evaluating the effects of advertising and media coverage of food quality and safety issues, investigating the role of trust and credibility of information sources and analysing consumer interest in and use of available information cues. Verbeke (2005)[60] found that information provision can be successful only if it meets the informational needs of the target audience. The provision of ever more and too detailed information entails the risk of information overload, resulting in consumer indifference or loss of confidence. Instead, segmentation and targeted information provision are proposed as potential solutions to market failure from information symmetries.

Much of today's information about food quality and safety can be classified as risk information that aims at reducing consumers' uncertainty when making purchasing decisions. Current failures of risk information to achieve its goals may stem from gaps in understanding the relationship between individual perceptions, information processing and behaviour (Langford et al 1999[61]). Research has shown that the public

tends to misjudge relative food risks, at least when compared with expert opinions (Lazo et al., 2000[62] and Hansen et al., 2003[63]). Providing (Marette et al 1999[64]) or withholding (Mazzocchi et al 2004b food quality or safety information to consumers may result in considerable welfare effects.

Mangen et al. (2005)[65] discuss a variety of intervention measures in the chicken meat chain to reduce campylobacter infections. Of interest in the present context is that they include intervention measures at the consumer level because a widespread dissemination of campylobacter or other food borne pathogens via the hand and work surfaces during the preparation of meals have been demonstrated in several studies (Gorman et al, 2002[66] and Humphrey et al, 2001[67]). They evaluate two existing information campaigns focusing on increasing kitchen hygiene and home freezing, respectively, to change consumer behaviour. They estimate the yearly costs of each campaign to be 0.75-1.5 Euro. Unfortunately, they do not assess the benefits of the information campaigns but simply claim that they are important instruments.

An increasing number of markets based and valuation studies have been performed on how advertising and public information affects consumer behaviour and consumers' preferences (cf. Smed & Denver, 2005). Bonnet & Simioni (2001) [68] used scanner data to estimate WTP for food quality, more specific consumer responses to origin labelling. Grunert (2005[69]) lists some CVM studies on food quality, discuss comsumers' price perception and habitual purchasing, and conclude that this plays a big role in food purchasing. He also points at the risk of repeating former trade-off's in purchase choices, and at the importance of reference prices for the stated WTP.

Smed and Jensen (2005)[70] investigate how media coverage of food safety crisis affects consumer behaviour in favour of safe products, and assess how consumers react, how long their preferences are influenced, and whether all consumers are influenced in the same way. More precisely, the study investigates the impact of negative press coverage of salmonella in eggs on the demand for pasteurised eggs. Hence, the focus is on a products that may be positively influenced by negative publicity abut another product. They find that the effect varies considerably across consumer groups. Most responsive to permanent news (news about the death of two people) are aged people, households located outside the capital and consumers with medium to low education. At the same time all households exhibit a positive trend in consumption of pasteurised eggs. The results are found using econometric analysis on media index.

Only a few quantitative studies using a stated preference approaches are found that address the issue of how information affects consumer behaviour (Hayes *et al,*2002 and Rozan et al.,2004). These two studies use price auctions as valuation method (see appendix A4). Hayes et al. (2002) analyse how information affects the demand for irradiation of food. Through a repeated trial second price auction for pork sandwiches, the respondents' willingness to pay for information is estimated. The respondents were provided with impartial information and then asked to join the auction. After bid rounds 1-5, the respondents were provided with different kinds of information. Scientific evidence is mainly favourable towards irradiation while advocacy groups stress risk related to irradiation. One group was provided with only positive information, one group with negative information and one group with both positive and negative information. Hayes et al. (2002) conclude that negative information dominates positive information.

Rozan et al. (2004) use a three step price auction (second price aution) procedure to analyse how newly released information about food safety affects consumers' willingness to pay for certified food products (checked for heavy metal contents) versus non-certified products (unknown content of heavy metal). Respondents are asked to state their purchase price for a familiar non-certified product, for example an apple. Hereafter information about a food safety indicator (cadmium content) is provided and the respondents are told that the product evaluated initially is of unknown quality. Further the respondents are informed about health risks. Lastly, a certified product satisfying public health standards is presented. The respondents are again asked to bid for both products, certified and non-certified. Rozan et al. (op cit) conclude that new information that is damaging for non-certified products induce a decrease in the buying price for non-certified products but not a significant increase in buying price for certified products.

Hamilton et al. (2003) use CVM to estimate WTP for long term effect on health and environmental quality from absence of pesticide residues in food. They find that education, gender, household food expenditure, income and ethnicity affect the WTP for the food quality attribute 'pesticide-free'. They also examine respondents support for government regulation of pesticide residues by examination of voting choice behaviour. They find that the voting behaviour and the willingness to pay estimate may be quite different. That is, some people do not support the pesticide regulation even though they express a high willingness to pay (that is, they value pesticide free food, but also the future freedom of choice), and some people do the opposite (do not value the pesticide free food, but value the increased level in environmental quality). Thus

willingness to pay and referendum choices are not the same which means that market– and political behaviour may differ depending on their personal characteristics

Table B4. Literature on risk perception, information and consumer behaviour

Author
Bonnet C. & M. Simioni (2001): Assessing consumer response to protected designation of origin labelling: a mixed multinomial logit approach
Botterill, L. & N. Mazur (2004): Risk & risk perception – A literature review
Fewer, L.; Miles, S. & R. Marsh (2002): The media and genetically modified foods: Evidence in support of social amplification of risk
Gorman, R., S. Bloomfield and C.C. Adley (2002): A study of cross contamination of food-borne pathogens in the domestic kitchen in the Republic of Ireland
Grunert, K.G. (2005): Food quality and safety: Consumer perception and demand
Hall, C.; Moran, D. & D. Allcroft (2004): The economic value of GM risk perceptions: A meta-analysis of WTP studies using multi-level modelling
Hansen, J., Holm, L., Freewer, L. J., Robinson, P. and Sandoe, P. (2003): Beyond the knowledge deficit: Resent research into lay and expert attitudes to food risks
Hobbs, J.E. (2002): Consumer demand for traceability
Humphrey, T.J., K.W. Martin, J. Slader and K. Durham (2001): Campylobacter spp. in the kitchen: spread and persistens
Krupnick, A. (2002): Commentary on: What determines the value of life? A meta-analysis
Langford, L, Marris, C. and O'Riordan, T. (1999): Public reactions to risk: social structures, images of science and the role of trust.
Lazo, J.K., Kinnell, J. and Fisher, A. 2000: Expert and layperson perceptions of ecosystem risk
Lloyd, A. (2003): Threats to the estimation of benefit: are preference elicitation methods accurate?
Mangen, M.-J. J., A.H. Havelaar & K.J. Poppe (2005): Controlling campylobacter in the chicken meat chain. Estimation of intervention costs
Marette, S, Crespi, J.M. and Schiavina, A. (1999): The role of common labelling in a context of asymmetric information
Meyer, G. (2002): Svin på den politiske spiseseddel
Rimal, A.; Fletcher, S. M; McWatters, K. H.; Misra, S. K. & S. Deodhar (2001): Perception of food safety and changes in food consumption habits: a consumer analysis
Rowe, G. & G. Wright (2001): Differences in expert and lay judgments of risk: Myth or reality?
Sandøe, P. & K. K. Jensen (2004): Fødevaresikkerhed: etisk tænkning kan fremme dialog
Siegrist, M. (2000): The influence of trust and perceptions of risks and benefits on the acceptance of gene technology
Sjöberg, L. (1999): Political decisions and public risk perception

Sjöberg, L. (2002a): Are received risk perception models alive and well?
Sjöberg, L. (2002b): Risk, politik och näringsliv
Smed, S. and Jensen, J.D. (2005): Food safety information and food demand.
Sjöberg, L. (2003): Risk communication between experts and the public: perceptions and intentions
Tidsskrift for Landøkonomi (2001): Tema: Sikre fødevarer og risikovurdering – jagten på de rigtige beslutninger?
Tveit, G. (2003): Den organiserede kritik halter
Verbeke, W. (2005): Agriculture and the food industry in the information age.
Viscusi, W. K. (1993): The value of risks to life and health

Appendix C: Descriptive statistics

Below the details and illustrations of the descriptive statistics that are described in chapter 4 are put forth. First, we present the socio-demographics and the tests for whether they are representative for the Danish population. The socio-demographics include gender, age, personal income, education, county, and children. Second, we present graphs over the attitudinal distributions. They are presented in chronological order according to the question numbers in the questionnaire (see Appendix A).

Gender

Figure C1. Actual and expected gender distribution

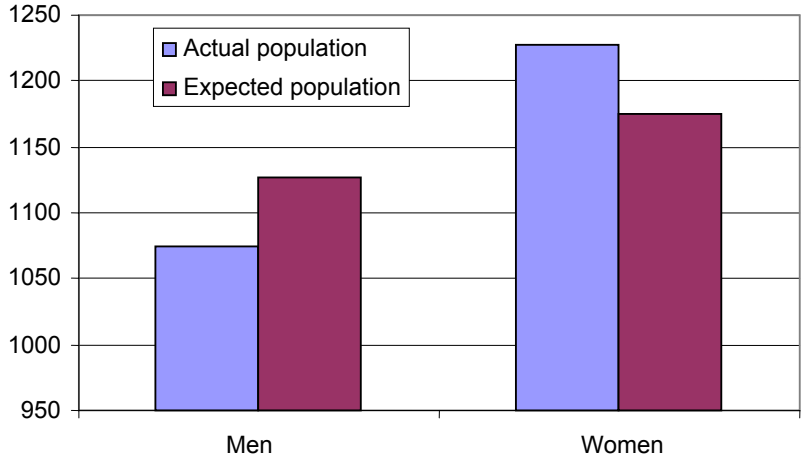


Table C1. Actual and expected gender distribution for the whole sample.

	The sample (A+B)		Statistics Denmark – exp. Population		
	Act. population	Percent	Population	Percent	Exp.population
Men	1074	0.467	2.059.069	0.490	1127
Women	1227	0.533	2.146.219	0.510	1174
In total	2301		4.205.288		2301

χ^2 (1) = 4.8222.

In table C2 and C3 the gender distribution of the two splits is compared with SD. The hypothesis that the gender distribution in split A is identical to the gender distribution id SD has a $\chi^2(1)=1.91659$. That is, the hypothesis cannot be rejected. This shows that there is some sort of obliquity between the two splits, which levels out when the two splits are separated. The change in significant level can partly be explained due to the degrees of freedom does not change with the change in sample size, from the total sample to sample A and B respectively. Similarly for sample B, the χ^2 (1) = 2.978264 shows that we can accept the hypothesis that the data are not significantly different.

Table C2. Actual and expected gender distribution for Sample A .

	Split A		Statistics Denmark – exp. Population		
	Act. population	Percent	Population	Percent	Exp.population
Men	554	0.469	2.059.069	0.490	578
Women	626	0.531	2.146.219	0.510	602
In total	1180		4.205.288		1180

$\chi^2(1) = 1.91659$

Table C3. Actual and expected gender distribution for sample B.

	A. split		Statistics Denmark – exp. population		
	Act. population	Percent	Population	Percent	Exp.population
Men	520	0.464	2.059.069	0.490	549
Women	601	0.536	2.146.219	0.510	572
In total	1121		4.205.288		1121

χ^2 (1) = 2.978264

Age

Table C4. Actual and expected age distribution in 8 different classes for the whole sample.

	The sample		Statistics Denmark – exp. Population		
	Act. population	Percent	Population	Percent	Exp. Population
18-19	36	0.01	117239	0.028	64
20-24	141	0.06	292541	0.070	160
25-29	205	0.08	345714	0.082	189
30-39	530	0.23	798106	0.190	437
40-49	508	0.22	771629	0.183	422
50-61	595	0.25	892435	0.212	488
62-66	207	0.09	278502	0.066	152
67-99	79	0.03	709122	0.169	388
In total	2301		4.205.288		2301

χ^2 (7) = 342.29

In tables C5 and C6 the dataset is split into A and B.

Table C5. Actual and expected age distribution in 8 different classes for Sample A.

	Sample A		Statistics Denmark – exp. Population		
	Act. opulation	Percent	Population	Percent	Exp. Population
18-19	20	0.017	117239	0.028	33
20-24	74	0.063	292541	0.070	82
25-29	92	0.078	345714	0.082	97
30-39	271	0.230	798106	0.190	224
40-49	271	0.230	771629	0.183	217
50-61	292	0.247	892435	0.212	250
62-66	112	0.095	278502	0.066	78
67-99	48	0.041	709122	0.169	199
In total	1180		4.205.288		1180

χ^2 (7) = 165.83. The hypotheses can be rejected (***) and the data can be said to be significant different.

Table C6. Actual and expected age distribution in 8 different classes for Sample B.

	Sample B		Statistics Denmark – exp. Population		
	Act. opulation	Percent	Act. population	Percent	Act. Population
18-19	16	0.014	117239	0.028	31
20-24	67	0.060	292541	0.070	78
25-29	113	0.101	345714	0.082	92
30-39	259	0.231	798106	0.190	213
40-49	237	0.211	771629	0.183	206
50-61	303	0.270	892435	0.212	238
62-66	95	0.085	278502	0.066	74
67-99	31	0.028	709122	0.169	189
In total	1121		4.205.288		1121

χ^2 (7) = 184.26. The hypotheses can be rejected (***) and the data can be said to be significant different.

Personal income

Table C7. Actual and expected income distribution for the whole sample.

	The sample				Statistics Denmark – exp. Population		
	Act. population	Percent	Act. population	Percent	Population	Percent	Exp. Population
Under 100.000	227	0.099	227	0.103	806062	0.186	410
100.000-149.999	202	0.088	202	0.092	814278	0.188	414
150.000-199.999	216	0.094	216	0.098	569099	0.131	289
200.000-249.999	335	0.146	335	0.152	610936	0.141	311
250.000-299.999	395	0.172	395	0.179	551126	0.127	280
300.000-399.999	482	0.209	482	0.218	592426	0.136	301
400.000-499.999	191	0.083	349	0.158	396540	0.091	202
500.000 or more	158	0.069					
Do not know	95	0.041					
In total	2301		2206		4.340.467		2206

χ^2 (6) = 474.09

With a chi value at 474.09 the two data are significantly different at the ***-level. In the data individuals with high or medium income are overrepresented, and individuals with low income are underrepresented. A partly explanation of this is that the distribution from Statistics Denmark include 15-17 years, with increase the representation of low income groups.

In table C8 the age group 18-19 years has been eliminated from the sample and the 15-19 years has been eliminated from the data from Statistics Denmark. The distributions now are a bit better, but still significant different from each other.

Table C8. Actual and expected income distribution for the sample – excluding the age group 18-19 and 15-19.

	The sample				Statistics Denmark – exp. population		
	Act. Population	Percent	Act. Population	Percent	Population	Percent	Exp. Population
Under 100.000	201	0.089	201	0.092	433529	0.115	251
100.000-149.999	201	0.089	201	0.092	711768	0.189	412
150.000-199.999	216	0.095	216	0.099	518923	0.138	301
200.000-249.999	335	0.148	335	0.154	579724	0.154	336
250.000-299.999	395	0.174	395	0.181	536063	0.143	311
300.000-399.999	482	0.213	482	0.221	585522	0.156	339
400.000-499.999	191	0.084	349	0.160	395520	0.105	229
500.000 or more	201	0.089					
Do not know	201	0.089					
In total	2265		2179		3.761.049		2179

χ^2 (6) = 287.92

Education

Figur C2. Actual and expected educational distribution for the sample.

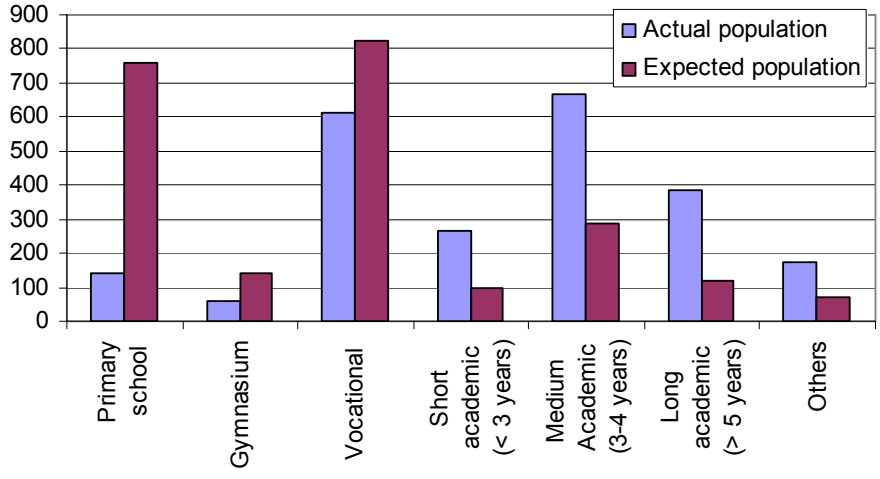


Table C9. Actual and expected educational distribution for the sample.

	The sample		Statistics Denmark – exp. population		
	Act. population	Percent	Act. Population	Percent	Act. population
Primary school	139	0.060	1.257.350	0.330	759
Gymnasium	60	0.026	232727	0.061	141
Vocational	612	0.266	1.368.425	0.359	826
Short academic (< 3 years)	265	0.115	160200	0.042	97
Medium Academic (3-4 years)	665	0.289	479902	0.126	290
Long academic (> 5 years)	386	0.168	199174	0.052	120
Others	174	0.076	113455	0030	68
In total	2301		3.811.233		2301

χ^2 (6) = 2137

Table C10. Actual and expected educational distribution for Sample A.

	Sample A		Statistics Denmark – exp. population		
	Act. population	Percent	Act. population	Percent	Act. population
Primary school	67	0.057	1.257.350	0.330	389
Gymnasium	32	0.027	232727	0.061	72
Vocational	322	0.273	1.368.425	0.359	424
Short academic (< 3 years)	132	0.112	160200	0.042	50
Medium Academic (3-4 years)	360	0.305	479902	0.126	149
Long academic (> 5 years)	171	0.145	199174	0.052	62
Others	96	0.081	113455	0.030	35
In total	1180		3.811.233		1180

χ^2 (6) = 1051

Table C11. Actual and expected educational distribution for Sample B

	Sample B		Statistics Denmark – exp. population		
	Act. popula-tion	Percent	Act. popula-tion	Percent	Act. popula-tion
Primary school	72	0.064	1.257.350	0.330	370
Gymnasium	28	0.025	232727	0.061	68
Vocational	290	0.259	1.368.425	0.359	402
Short academic (< 3 years)	133	0.119	160200	0.042	47
Medium Academic (3-4 years)	305	0.272	479902	0.126	141
Long academic (> 5 years)	215	0.192	199174	0.052	59
Others	78	0.070	113455	0.030	33
In total	1121		3.811.233		1121

χ^2 (6) = 1119

County

Figure C3. Actual and expected county distribution for the sample.

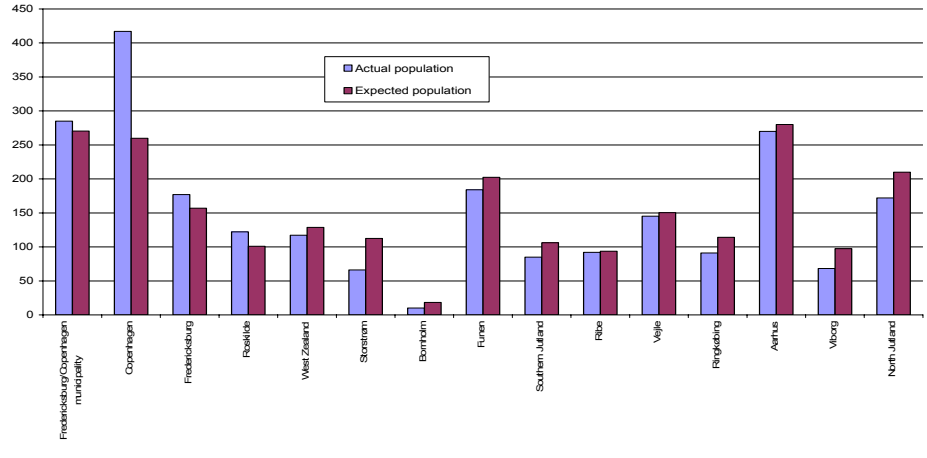


Table C12. Actual and expected county distribution for the sample.

	The sample		Statistics Denmark – exp. population		
	Act. population	Percent	Act. population	Percent	Act. population
Fredericksburg/Copenhagen municipality	285	0.124	467945	0.117	270
Copenhagen	417	0.181	450017	0.113	260
Fredericksburg	177	0.077	271726	0.068	157
Roskilde	122	0.053	174948	0.044	101
West Zealand	117	0.051	223015	0.056	129
Storstrøm	66	0.029	194540	0.049	112
Bornholm	10	0.004	31856	0.008	18
Funen	184	0.080	350530	0.088	202
Southern Jutland	85	0.037	183473	0.046	106
Ribe	92	0.040	162111	0.041	94
Vejle	145	0.063	260302	0.065	150
Ringkøbing	91	0.040	197460	0.050	114
Aarhus	270	0.117	485118	0.122	280
Viborg	68	0.030	168415	0.042	97
North Jutland	172	0.075	363522	0.091	210
In total	2301	1	3.984.978	1	2301

χ^2 (14) = 153.48

Table C13. Actual and expected county distribution for the sample without Copenhagen, Storstrøm, Viborg and North Jutland municipalities.

	The sample		Statistics Denmark – exp. population			
	Act. population	ercent	Act. population	Percent	Act. tion	popula-
Fredericksburg/Copenhagen municipality	285	0.181	467945	0.167		263
Fredericksburg	177	0.112	271726	0.097		153
Roskilde	122	0.077	174948	0.062		98
West Zealand	117	0.074	223015	0.079		125
Bornholm	10	0.006	31856	0.011		18
Funen	184	0.117	350530	0.125		197
Southern Jutland	85	0.054	183473	0.065		103
Ribe	92	0.058	162111	0.058		91
Vejle	145	0.092	260302	0.093		146
Ringkøbing	91	0.058	197460	0.070		111
Aarhus	270	0.171	485118	0.173		273
In total	1578	1	3.984.978	1		1578

χ^2 (14) = 23.14

Children

Figure C4. Actual and expected distribution of the number of children of the respondents in the sample.

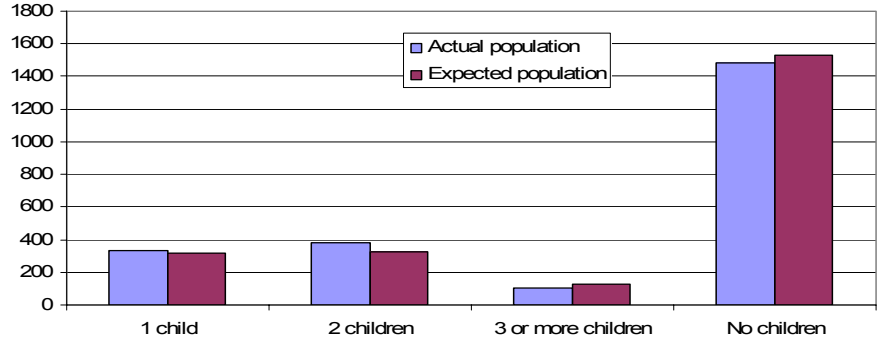


Table C14. Actual and expected distribution of the number of children of the respondents in the sample.

	The sample		Statistics Denmark – exp. population		
	Act. population	Percent	Act. population	Percent	Act. population
1 child	337	0.146	549943	0.138	318
2 children	378	0.164	559444	0.140	323
3 or more children	105	0.046	222672	0.056	129
No children	1481	0.644	2.652.986	0.666	1532
In total	2301		3.985.045		2301

χ^2 (3) = 16.56

Table C15. Actual and expected distribution of the number of children of the respondents in the sample when pooling two groups.

	The sample		Statistics Denmark – exp. population		
	Act. population	Percent	Act. population	Percent	Act. population
1 child	337	0.146	549943	0.138	318
2 or more children	483	0.210	782116	0.196	452
No children	1481	0.644	2.652.986	0.666	1532
In total			3.985.045		

χ^2 (2) = 5.06

Description of data with respect to attitudes

Figure C5. Question 6: It is important that the price is low

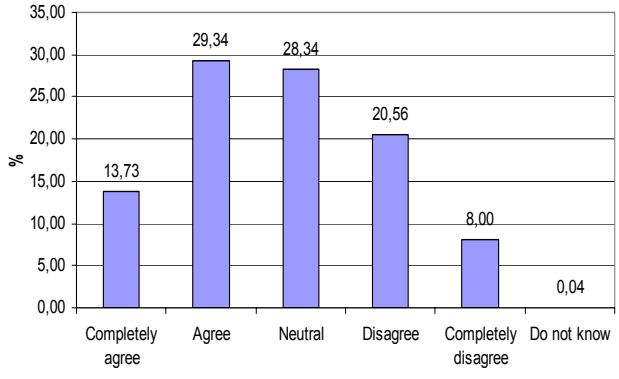


Figure C6. Question 6: It is important that the product is organic

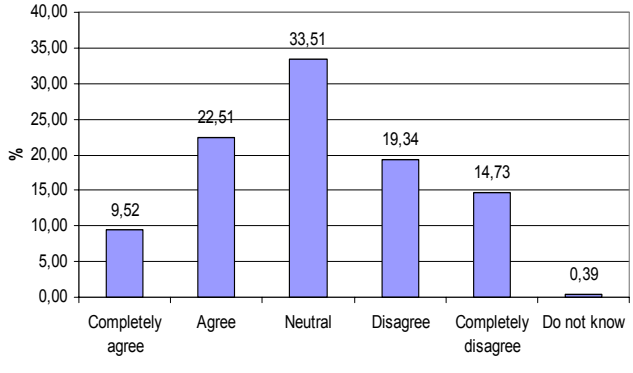


Figure C7. Question 6: It is important that the product is low-fat

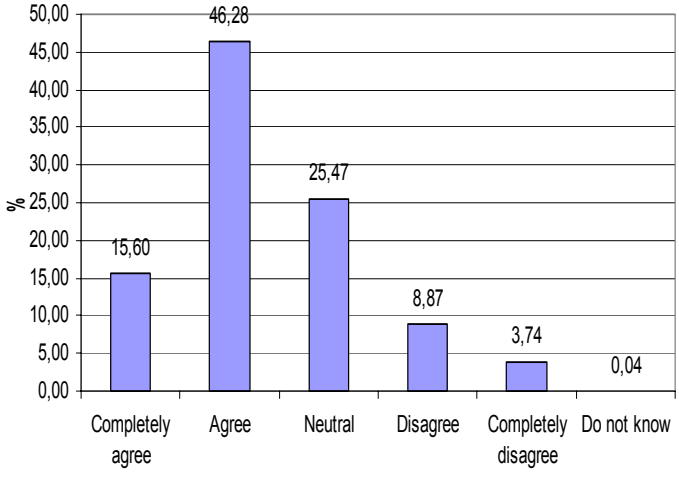


Figure C8. Question 6: It is important that the product appears tempting

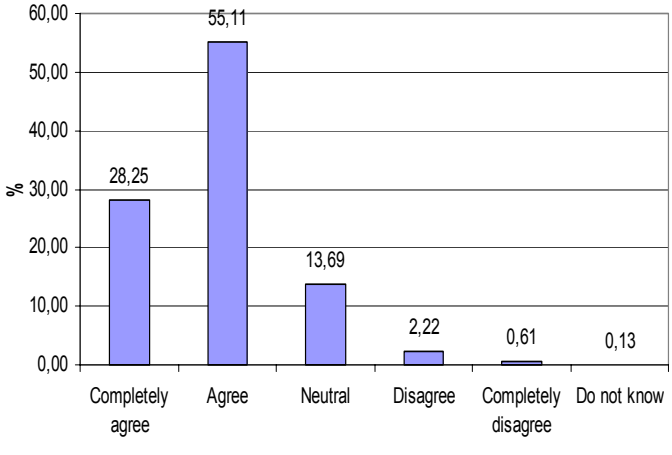


Figure C9. Question 6: It is important that the product is produced in Denmark

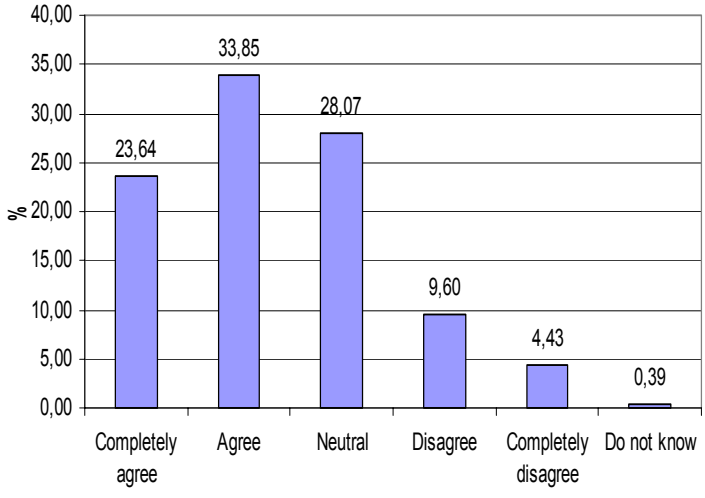


Figure C10. Question 6: It is important that the product is of good quality

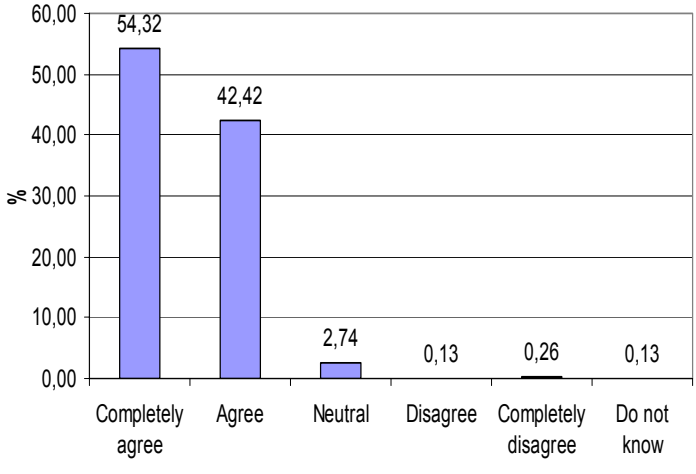


Figure C11. Question 7: Do you believe it is possible to avoid campoly-bacter by maintaining good hygiene

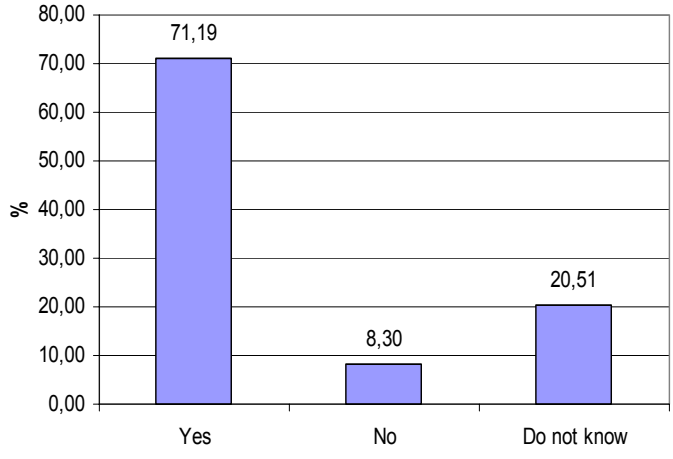


Figure C12. Question 8: Do you think that your household maintain good hygiene basics in the kitchen?

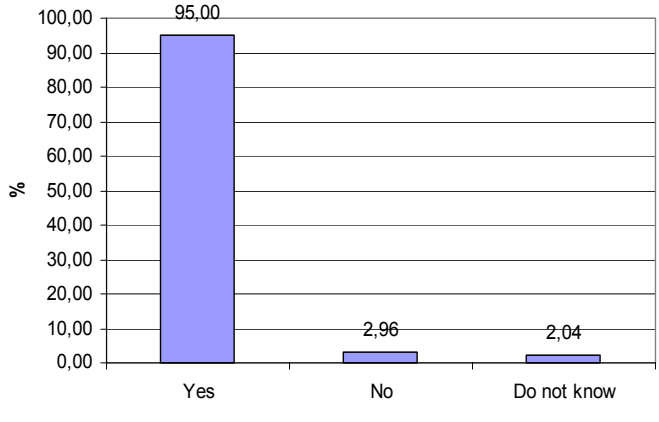


Figure C13. Question 14: The welfare of outdoor-reared chickens is better than that of indoor-reared chickens

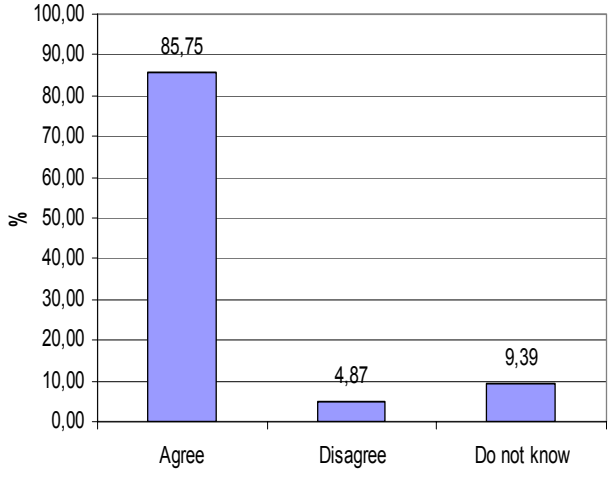


Figure C14. Question 14: Outdoor-reared chickens are more likely to be infected with campylobacter than are indoor-rear3ed chickens

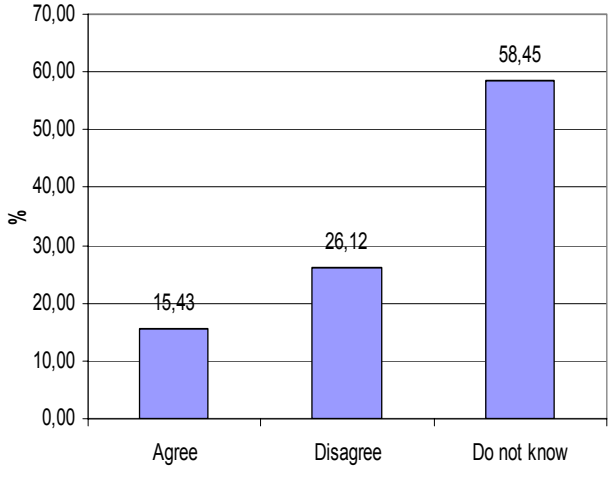


Figure C15. Question 15: I think there is too much hysteria surrounding the animal welfare issue

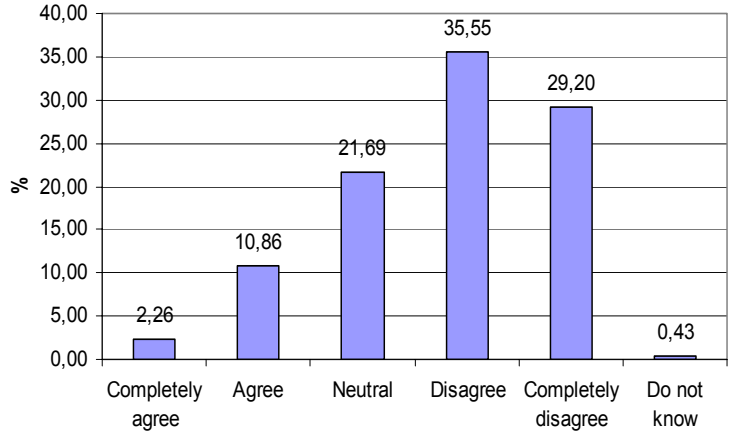


Figure C16. Questions 15: I support animal welfare through my choice in food products

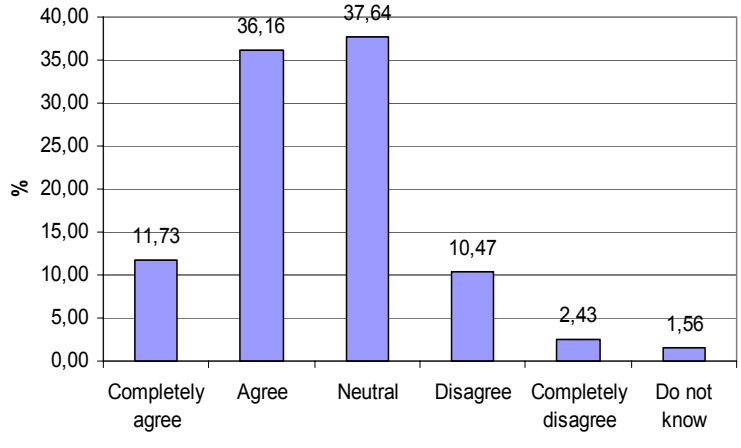


Figure C17. Question 15: I think that outdoor-reared chickens taste better than indoor-reared chickens

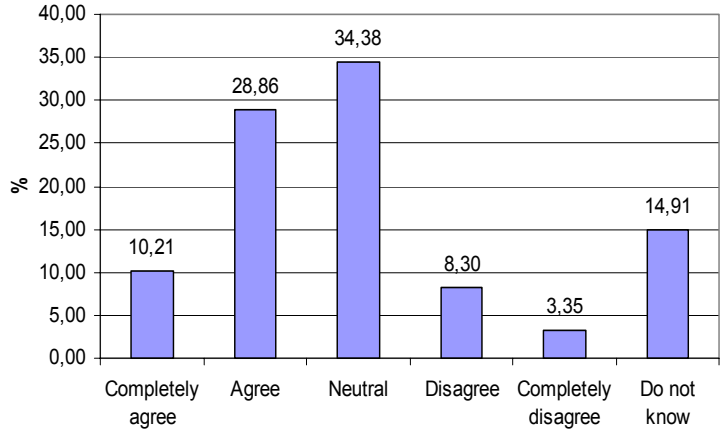


Figure C18. Question 15: Although infection by campylobacter can be prevented through maintaining good hygiene basics and correct food preparation practices, I do not want to have campylobacter bacteria in my kitchen.

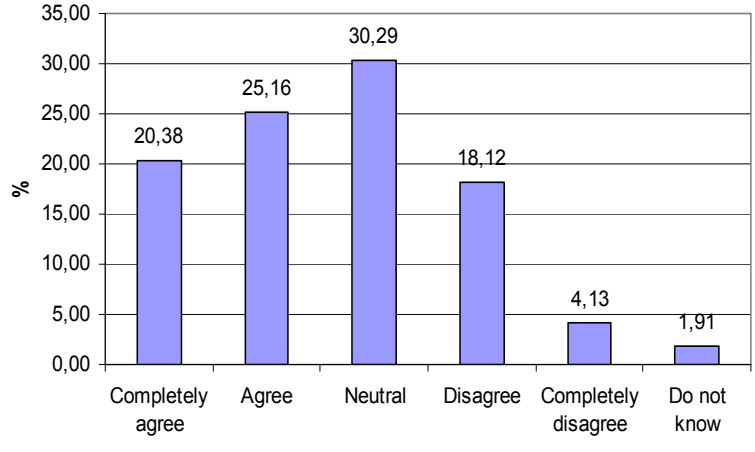


Figure C19. Question 15: I think there is too much hysteria surrounding the campylobacter issue

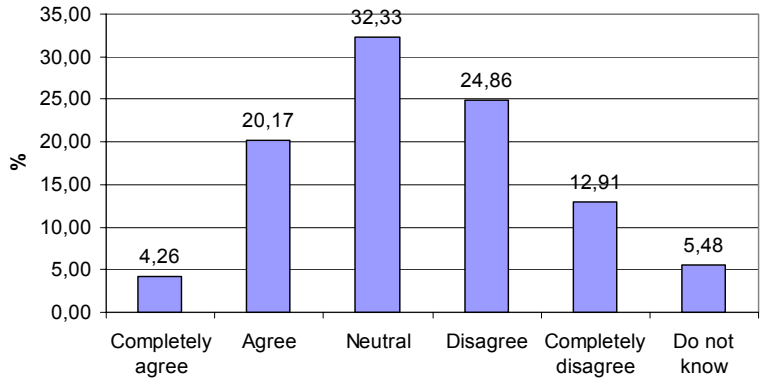


Figure C20. Question 15: I believe that the producers are responsible for supplying food products that carry no health risks for the consumers

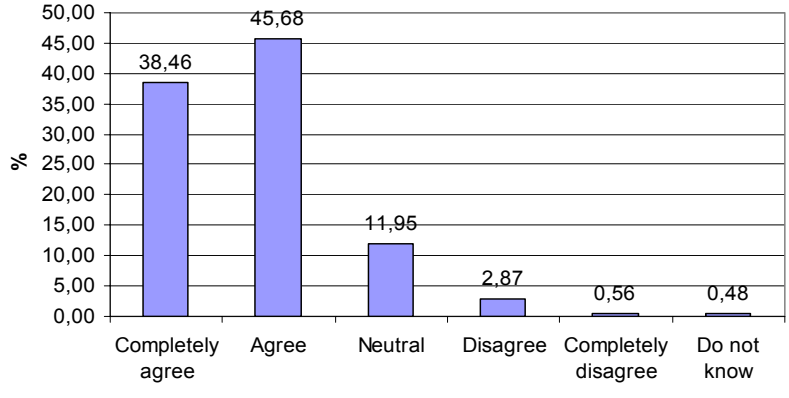


Figure C21. Question 15: If the authorities could ensure reliable marking, I would be happy to pay extra for campylobacter-free chicken

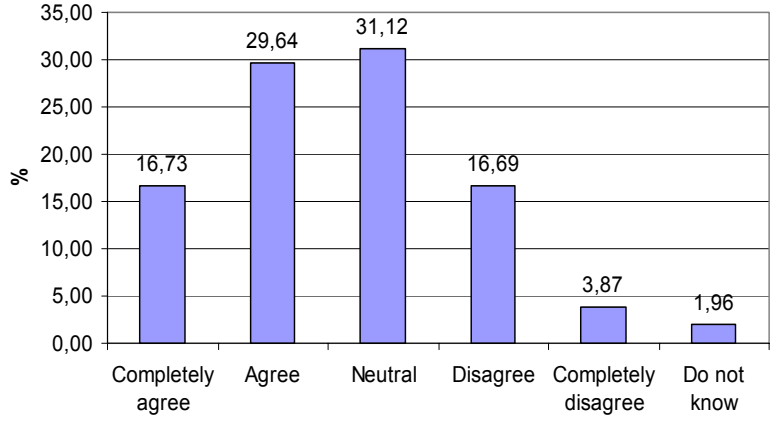


Figure C22. Question 15: If the authorities could ensure reliable marking, I would be happy to pay extra for increased animal welfare

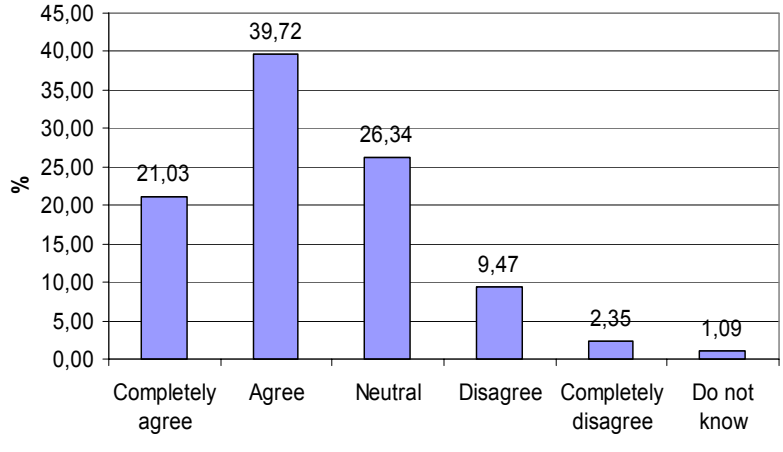


Figure C23. Question 15: I believe that the authorities are responsible for carrying the costs of ensuring campylobacter-free chicken meat.

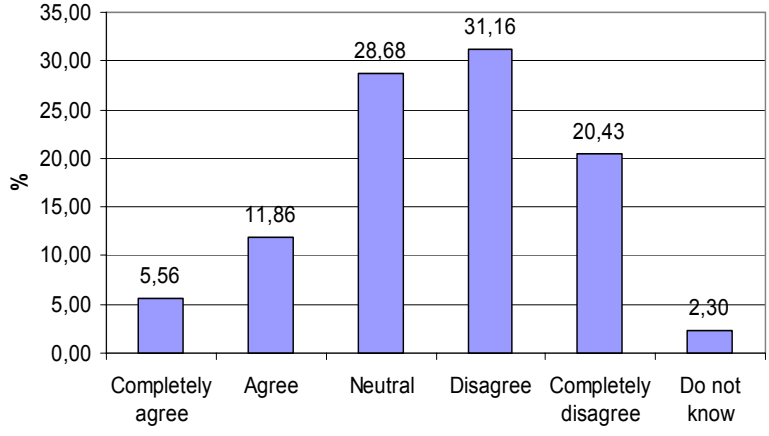


Figure C24. Question 15: I believe that the authorities are responsible for carrying the costs of increased animal welfare

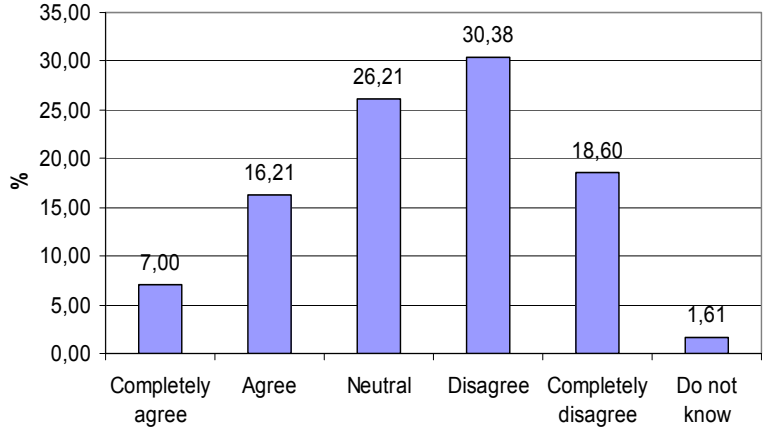


Figure C25. Question 15: I believe that eating Danish food products carries no health risks

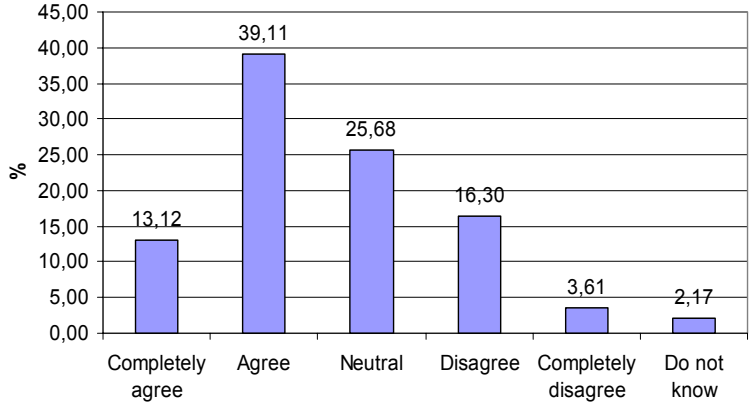


Figure C26. Question 16: I have sufficient information when I buy food products

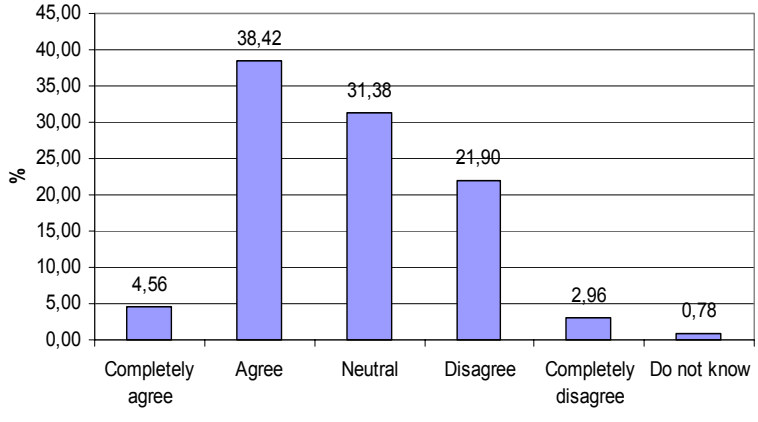


Figure C27. Question 16: I have confidence in the information supplied by the Danish Institute for Food and Veterinary Research

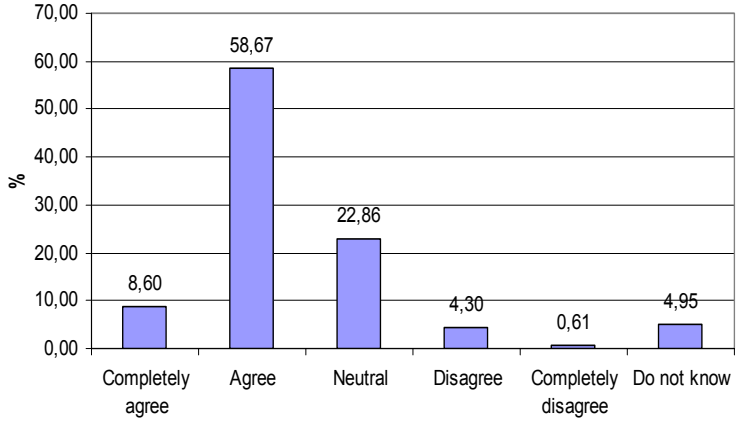


Figure C28. Question 16: I have confidence in the product information supplied by the producers

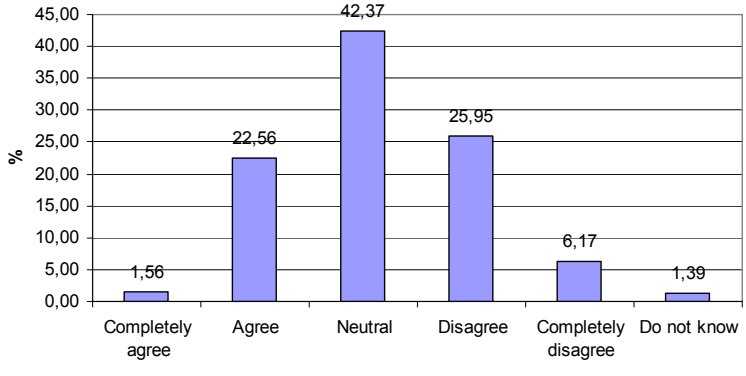


Figure C29. Question 16: I have confidence in the Ø-label (a label that shows that the article is an organic product produced under control of the Danish authorities)

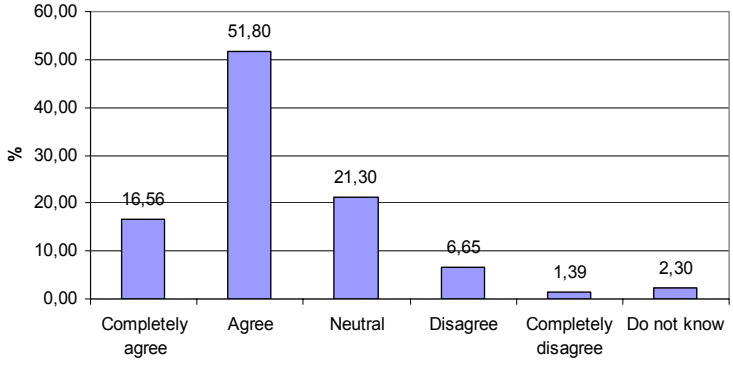


Figure C30. Question 16: I have confidence in the information supplied by the Ministry of Food, Agriculture and Fisheries

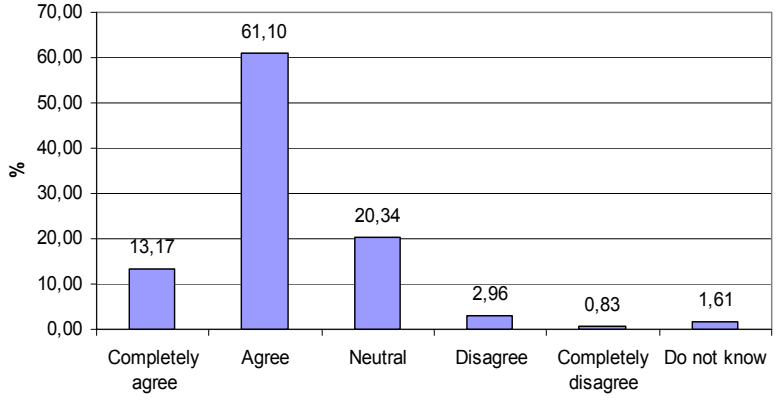


Figure C31. Question 16: I have confidence in the information supplied by the Danish Consumer Council, e.g. through the independent consumer magazine "Tænk"

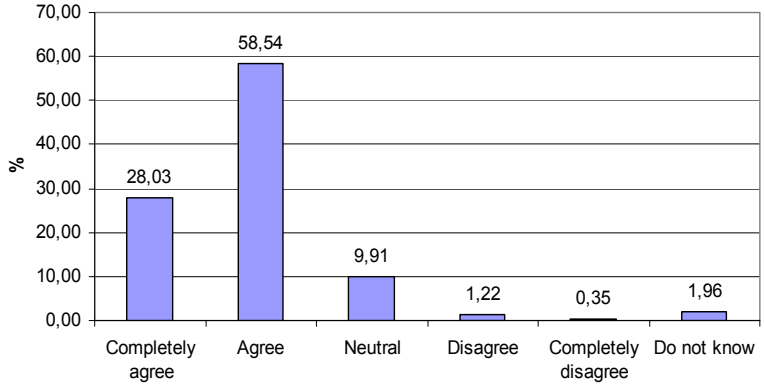


Figure C32. Question 16: I have confidence in the informative labelling of consumer goods

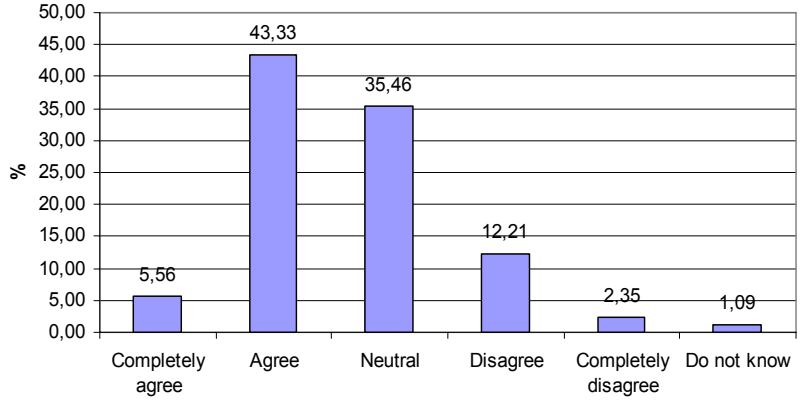


Figure C33. Question 17 and 18: The respondents former knowledge about respectively campylobacter and salmonella

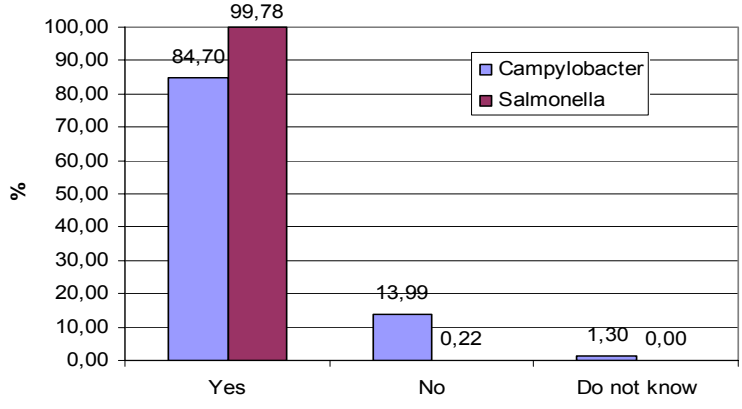


Figure C34. Question 19: Has your knowledge of salmonella influenced your responses in this questionnaire?

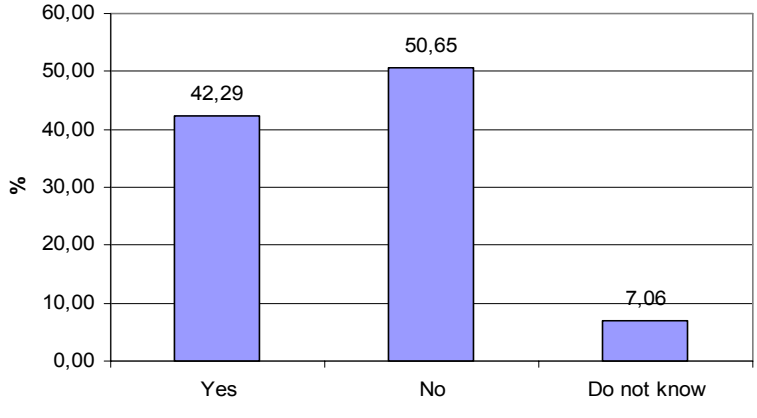


Figure C35. Question 20: Are you at an increased risk of infection by campylobacter due to diminished health?

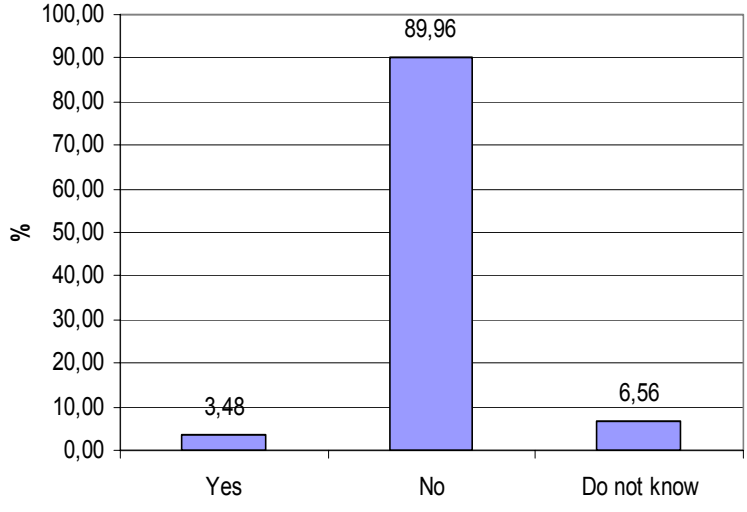


Figure C36. Question 21: Have you or anyone you know of ever been ill from campylobacter?

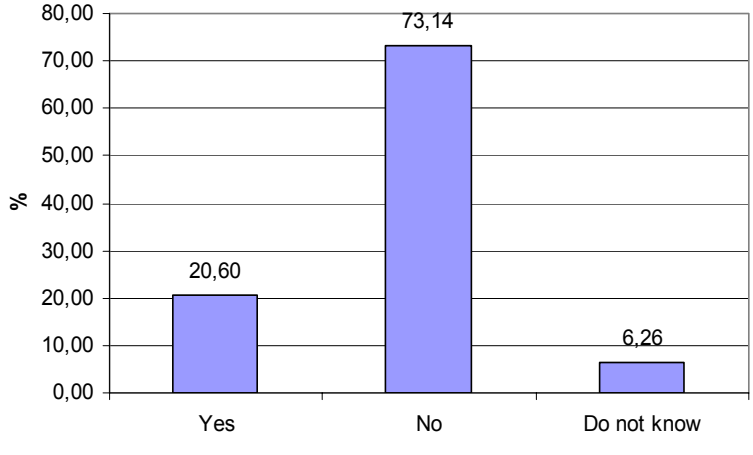


Figure C37. Question 22A: What kind of chicken meat product do you usually buy?

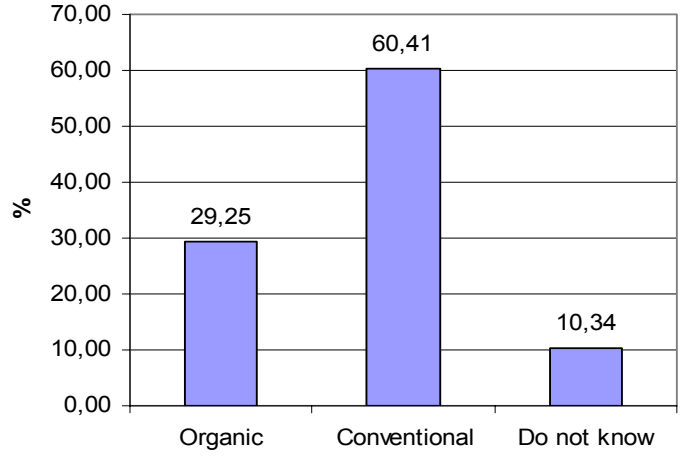


Figure C38. Question 22B: What kind of chicken meat product do you usually buy?

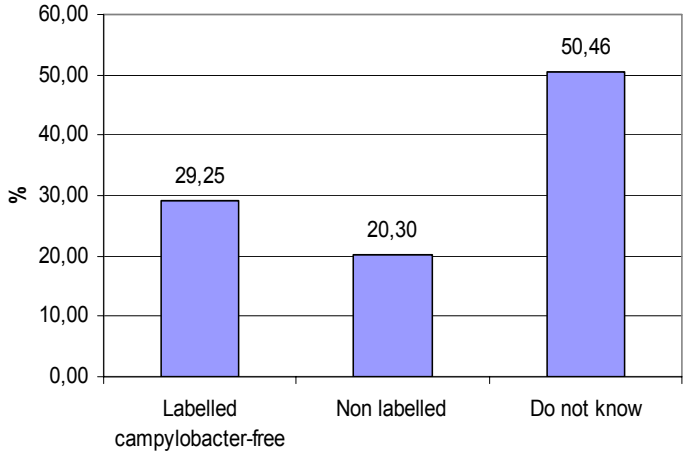


Figure C39. Question 20 and age: Respondents' opinion of their on health (yes: bad, no: good) dependent of their age

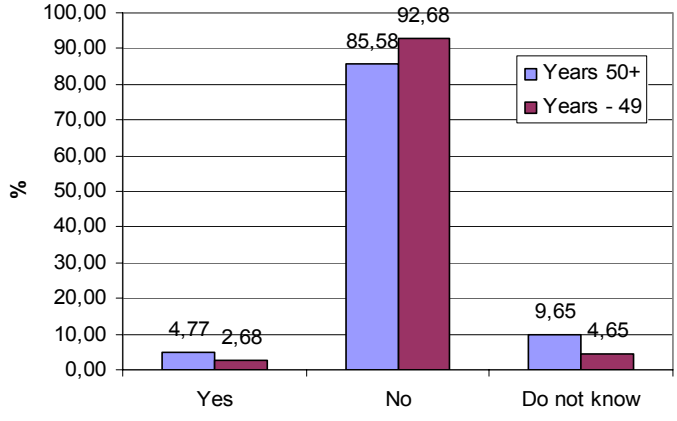


Figure C40. Question 23: What is the approximate price you usually pay for a chicken?

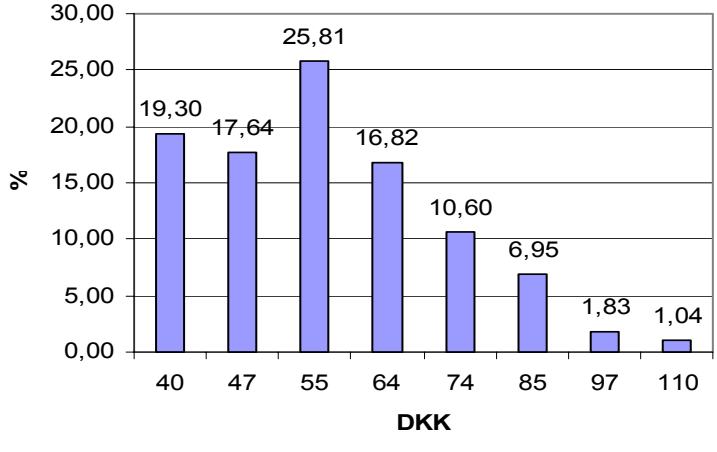
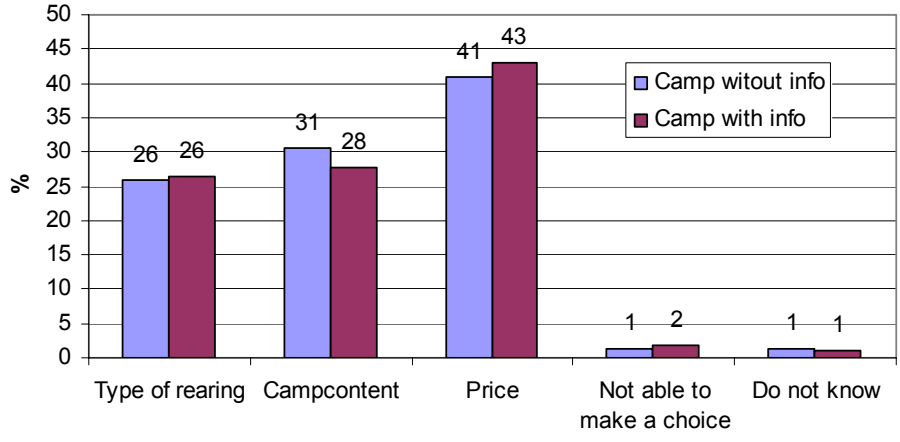


Figure C41. Question 5 and 13: To which of the following properties did you attach the greatest importance in the above shopping scenarios?



Appendix D: Coding

An important issue in the discrete choice modeling is how to code the qualitative explanatory variables. The main reason for testing different coding schemes in the present context is to find the best way to include the opt-out alternative. The complete analysis of how the opt-out is modeled is shown in appendix E. All the estimated models below are based on the conditional logit model. The estimated parameters for two coding schemes - dummy coding and effect coding – are presented.

Dummy coding

Dummy coding of campylobacter-free and outdoor (with zero valued opt-out)

All qualitative attributes are coded 0 or 1, where 1 indicates the appearance of the attribute level described (Louviere et al. 2000).

Figure D.1. Data setup - dummy coding of attributes – no alternative specific constants for the opt-out alternative

Id	Alt	**outdoor**	**campylobacter-free**	price	optout	choice
1	1	**1**	**0**	110	0	0
1	2	**0**	**1**	47	0	1
1	3	**0**	**0**	0	0	0
1	1	**0**	**0**	47	0	0
1	2	**1**	**1**	74	0	1
1	3	**0**	**0**	0	0	0
1	1	**0**	**1**	97	1	0
1	2	**1**	**0**	55	1	0
1	3	**0**	**0**	0	1	1
1	1	**0**	**1**	64	0	0
1	2	**1**	**0**	40	0	1
1	3	**0**	**0**	0	0	0

Notes: *Alt 1* and *alt 2* are real alternatives, *alt 3* is the opt-out alternative defined with zero values. *Optout* specifies whether the respondent have chosen the optout alternative, i.e. *alt 3*.

A problem with dummy coding, as we see it, is when the opt-out alternative is modeled with zero levels. Then STATA/SAS can not distinguish between the 0-level for the opt-out alternative and the '0' in one of the two 'real' alternatives (Alt 1 and 2).

So the opt out alternative can not be distinguished from an alternative without campylobacter labels and from indoor production.

Dummy coding (with ASC and zero valued opt-out)
A possible solution to correct for this problem include an alternative specific constant (ASC) for the opt-out alternative (a new dummy variable '**optoutvar**'). This variable will explain the effects not included in the original attributes – the average effect of omitted variables (Louviere et al. 2000). An ASC is also used by Paulrud & Laitila 2004, Kontoleon & Yabe 2003, Ruby et al. 1998.

Figure D.2. Data setup - dummy coding of attributes and the opt-out alternative

Id	Alt	outdoor	campylobacter-free	**Optoutvar**	price	Optout	choice
1	1	1	0	**0**	110	0	0
1	2	0	1	**0**	47	0	1
1	3	0	0	**1**	0	0	0
1	1	0	0	**0**	47	0	0
1	2	1	1	**0**	74	0	1
1	3	0	0	**1**	0	0	0
1	1	0	1	**0**	97	1	0
1	2	1	0	**0**	55	1	0
1	3	0	0	**1**	0	1	1
1	1	0	1	**0**	64	0	0
1	2	1	0	**0**	40	0	1
1	3	0	0	**1**	0	0	0

Notes: Alt 1 and alt *2* are real alternatives, alt 3 is the opt-out alternative defined with zero values. We note that in the main analysis, the opt-out alternative is defined with person specific values. The optoutvar is included in the main analyses.

Another way to correct for the problem is to create two ASC's, one for each real alternative. This is not shown here, but an estimation run has been completed – see the estimation later in this section (This coding has been used by Adamowicz et al. 1997).

The choice between different coding schemes are only based on models using a conditional logit model, because this is the most simple and least time consuming model to use.

Table D1 shows results from the setup where we have dummy coded the 'opt-out' and the two attributes 'outdoor' and 'campylobacter-free (c.f. figure D2).

Table D.1. Results from the estimation procedure using dummy coded variables for the separate data sets with and without information

Sample A	Without campylobacter information		With campylobacter information	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,646079	0,031240	0,6805696	0,0305280
Campylobacter-free	0,928247	0,032984	0,7576650	0,0315953
Price	-0,039225	0,001032	-0,0360747	0,0009796
Alternative Specific Constant (ASC)	-2,482728	0,074391	-2,4247620	0,0720471
LRI	**0,2225**		**0,2099**	
N	**7696**		**7696**	
Log L	**-6574**		**-6681**	
Sample B				
Choice	**Without animal welfare information**		**With animal welfare information**	
Outdoor bred	0,6840166	0,0324562	1,3221860	0,0358754
Campylobacter-free	0,8549176	0,0340624	0,6986461	0,0343959
Price	-0,0414757	0,0010816	-0,0316932	0,0009633
Alternative Specific Constant (ASC)	-2,6425310	0,0771924	-1,5394870	0,0720216
LRI	**0,2278**		**0,2273**	
N	**7252**		**7252**	
Log L	**-6153**		**-6157**	

Effect coding

Effect coding ((with ASC and zero values opt-out)

Instead of coding the attributes as dummy variables, they can be effect coded according to Louviere et al. (2000). All qualitative attributes are coded -1 or 1, where 1 indicates the appearance of the attribute level described. Adamowicz et al. (1994) presents the differences in the two coding schemes. He argues that when using dummy coding, the ASC confounds with the effects of interest. This is not the case when using the effect coding scheme, which orthogonalizes the attribute effects to the constant. Furthermore he concludes that 'either coding scheme should produce the same estimates up to a positive linear transformation'. As shown later, choice of coding system only affects the coefficients of the ASC. Though the effect coding scheme gives rise to problems in calculating the confidence intervals (Bech 2005).

Figure D.3. Data setup – effect coded

Id	Alt	**outdoor**	**Campylobacter**	Optoutvar	price	optout	choice
1	1	**1**	**-1**	0	110	0	0
1	2	**-1**	**1**	0	47	0	1
1	3	**0**	**0**	1	0	0	0
1	1	**-1**	**-1**	0	47	0	0
1	2	**1**	**1**	0	74	0	1
1	3	**0**	**0**	1	0	0	0
1	1	**-1**	**1**	0	97	1	0
1	2	**1**	**-1**	0	55	1	0
1	3	**0**	**0**	1	0	1	1
1	1	**-1**	**1**	0	64	0	0
1	2	**1**	**-1**	0	40	0	1
1	3	**0**	**0**	1	0	0	0

Table D2 shows result from the setup, where we have effect coded the opt-out and the attributes ‘outdoor’ and ‘campylobacter-free (c.f. figure D3).

Table D.2. Results from the estimation procedure using effect coded variables for the separate data sets with and without information

Sample A	Without campylobacter information		With campylobacter information	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,323040	0,015620	0,3402848	0,0152640
Campylobacter-free	0,464124	0,016492	0,3788325	0,0157977
Price	-0,039225	0,001032	-0,0360747	0,0009796
Alternative Specific Constant (ASC)	-3,269891	0,075494	-3,1438800	0,0726536
LRI	**0,2225**		**0,2099**	
N	**7696**		**7696**	
Log L	**-6574**		**-6681**	
Sample B				
Choice	**Without breeding information**		**With breeding information**	
Outdoor bred	0,3420083	0,0162281	0,6610931	0,0179377
Campylobacter-free	0,4274588	0,0170312	0,3493230	0,0171979
Price	-0,0414757	0,0010816	-0,0316932	0,0009633
Alternative Specific Constant (ASC)	-3,4119980	0,0787549	-2,5499030	0,0702828
LRI	**0,2278**		**0,2273**	
N	**7252**		**7252**	
Log L	**-6153**		**-6157**	

Comparing dummy and effect coding

Comparison of Table D1 and Table D2 shows that the coefficients for the effect coded attributes (table D2) are halved compared with the dummy coded attributes (table D1). This is due to the range between the coded level-values (effect coded there range is 2, dummy coded the range is 1). Therefore the coefficients in the effect coded model have to be corrected (multiplied with 2) when the estimates are to be interpreted (when marginal rates of substitution are interpreted, no correction is needed) (Bech 2005).

The choice between the different coding schemes is not discussed much in the literature. Louviere et al. (2000) provides an easy statement towards the issue. They state that it is 'largely up to the analyst' to make the choice between dummy – and effect coding. Adamowicz *et al*. (1994) states that the only difference in the coefficient values between the two models after the correction, is the coefficient value for the alternative specific constant (the opt-out-variable), which explains the remaining effects (and/or the 'noise') not explained by the identified attributes.

As ASC is not used to calculate the willingness to pay estimates and because the fits of the models are not affected by the choice of coding scheme – we choose the dummy coding scheme.

Appendix E: Opt-out

The objective of this appendix is to argue why and how we include opt-out in the data estimation. First, we discuss how the opt-out alternative is interpreted (modelled). Second, we discuss how the value of an opt-out option is identified. We present 4 approaches of including an opt-out option.

Why?
Opponents of including an opt-out option in the choice sets state that the respondents are given a too easy way out, when they are faced with difficult choice situations (Luce 1998). Proponents of including an opt-out option in the choice sets state that including an opt-out alternative is necessary in order to obtain welfare measures that are consistent with economic theory (Bateman et al. 2002; Adamowicz & Boxall 2001). Furthermore they state that the results will be overestimated (Boyle et al., 2001) if the respondents are not given an opt-out opportunity, because they can be forced to an alternative they do not want, thereby placing a positive willingness to pay on an alternative where they in fact should have placed zero value. Another possibility could be to include an opt-out option in the choice sets and then following remove the opt-out responses in the estimation phase. Thereby, respondents are not forced to choose an alternative that they really rather would be without. However, this procedure raises another problem as important information might be lost when throwing away all opt-out choices.

Ruby et al. (1998) concludes that it depends on the situation which 'opt-out variant' to use. They state that if the respondents are used to purchase the good in question, their 'own' opt-out values should be included. But if they are not used to purchase the good or if there are very limited real substitutes present, the respondents should opt-out to a 'no-purchase' alternative without their 'own' opt-out values.

In our choice experiment, the opt-out alternative was chosen 15% of the times hence, important information might be lost if we do not include the respondents who have opted out in the estimations. Considering the pros and cons, we have decided to include the op-out in the choice sets as well as in the statistical analyses – even though, the inclusion of opt-out gives rise to complications in the analysis (Kontoleon & Yabe 2003).

How?

In our questionnaire we ask respondents to state which kind of chicken-product they usually buy. That is, whether they by organic or not organic (this is the closest we can get to outdoor/indoor productions) and whether they buy chicken labelled campylobacter-free or not, and at what price. These answers are used to characterize the opt-out alternative instead of the zero-values in table E3. The respondents now choose between two alternatives and a status quo product – the product they usually buy.

In the underlying questionnaire, respondents opt-out to 'none of these two'. This opt-out formulation was chosen in order to extract as little attention as possible to the attributes before the choice tasks. The back side of the chosen procedure is that we have no information concerning the opt-out alternative – in particular, the opt-out alternative is not described by any attributes (or attributes levels). To remedy this problem, the respondents are asked (after completing the choice tasks) to express their usual purchase of chicken products. These answers are used in the estimations below by using the individual-specific values of the attributes as opt-out values.

Different approaches to include the opt-out are now set forth and examined – these include

1. setting all attributes equal to zero in the opt-out option,
2. using the respondents own values as opt-out values,
3. including an alternative specific constant and
    a. setting all attributes equal to zero in the opt-out option
    b. using the respondents own values as opt-out values.

We will present these 4 approaches to include an opt-out. The models are estimated using dummy coding of the variables – including dummy coding of the opt-out option - as described in appendix C). For further discussions about the choice between different coding schemes see appendix D. All opt-out models are estimated using a probit model and the models are estimated on the two data sets, A and B - including only main effects. As the question of how to include the opt-out option in the estimations had to be answered very early in the estimation process, the estimations are based on models other than the final model (main effects only and including attributes with and without campylobacter information as well as with and without breeding information).

Setting all opt-out values equal to zero

When valuing a change, e.g. an environmental change, the opt-out alternative is typically a status quo situation, with specific levels of the describing characteristics (Olsen et al. 2005; Lundhede et al. 2005; Hasler et al. 2005). This is more or less easy for issues relating to the environment, which mostly can be seen as a static situation towards the group of respondents in contrast to a shopping situation, where each individual can decide which product to purchase. Because of this, the solution of setting the opt-out alternative as a fixed status quo situation with fixed attribute levels for the entire sample will be erroneous for a large part of the respondents. A solution to this could be to set all attribute levels equal to zero for the opt-out alternative.

Table E.1. Results from the estimation procedure using zero values for the levels of the opt-out alternative in the separate data sets with and without information

Sample A	Without campylobacter information		With campylobacter information	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,737400	0,028100	0.7551	0.0278
campylobacter-free	0,872800	0,028800	0.7711	0.0282
Price	-0,010400	0,000408	-0.009099	0.000406
LRI	**0,2215**		**0,2164**	
N	**4720**		**4720**	
Log L	**-4037**		**-4063**	
Sample B	**Without breding information**		**With breeding information**	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,772700	0,029100	1,1555000	0,0315000
campylobacter-free	0,806300	0,028900	0,6915000	0,0309000
Price	-0,010200	0,000420	-0,0129000	0,0004520
LRI	**0,2153**		**0,2610**	
N	**4484**		**4484**	
Log L	**-3866**		**-3641**	

The problem with this solution in our context is how to understand the zero levels for the attributes animal welfare and food safety? The 0-level for the price attribute is straight forward. If you do not buy the product you do not pay any money. But what is a 0-level for the animal welfare attribute and the food safety attribute?

Person specific opt-out values

In some questionnaires, the respondents are asked to state their usual choice of product before the choice experiments are made. In the actual choice tasks, the respondents are instructed to think of the product they usually buy when they opt-out. However, the researcher can not be certain that the respondents have this usual product in mind, when choosing between alternatives. Such approach was used by Ruby et al. (1998) and by Kontoleon & Yabe (2003). The argument for incorporating the respondents 'own' opt-out value is to mimic the actual choice situations faced by the individuals as closely as possible (Batsell & Louviere 1991) and to achieve as much information as possible about the opt-out alternative.

In our choice experiment, we use the scenario description to emphasize that the respondents are to imagine that they would like to purchase a whole chilled chicken. Our intentions are that when they opt-out, it should be to another chicken – which we expect to be the chicken they usually buy. This would support including the respondents own opt-out values. However, we have not been able to test whether the respondents were thinking of the opt-out as intended.

In our design, the respondents are asked to state their usual choice of chicken, when purchasing a whole chilled chicken, after the ordinary choice experiment is performed. Therefore, the respondent is not really faced with a choice situation with three alternatives. Instead, we try to mimic a choice situation with 3 choices in the preceding estimation process. Table E3 shows the estimations using personal opt-out values.

Table E.2. Results from the estimation procedure using the respondents own values for the opt-out alternative in the separate data sets with and without information

Sample A	Without campylobacter information		With campylobacter information	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,526700	0,024000	0,5777000	0,0241000
Campylobacter-free	0,589600	0,025600	0,5567000	0,0258000
Price	-0,017300	0,000591	-0,0170000	0,0006120
LRI	**0,2126**		**0,2162**	
N	**4720**		**4720**	
Log L	**-4083**		**-4064**	
Sample B	**Without breeding information**		**With breeding information**	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,593300	0,024800	0,9385000	0,0343000
Campylobacter-free	0,573700	0,026000	0,5491000	0,0325000
Price	-0,018700	0,000641	-0,0181000	0,0007170
LRI	**0,2254**		**0,2360**	
N	**4484**		**4484**	
Log L	**-3816**		**-3764**	

As can be seen from the tables above (E1 & E2), the parameter estimates changes. The magnitude of the change can really be seen when we calculate the willingness to pay estimates. In example, for sample B – the animal welfare attribute decreases from DKK 76 when opt-out values are zero to DKK 32 when respondents' own opt-out values are included. This reduction in willingness to pay is due to an increase in the value that respondents place on the price attribute in the opt-out alternatives. That is without the respondents own values the 'observed' value of the price parameter was zero, whereas with the respondents own values it has increased from zero to DKK 40 or above.

Incorporating the value of the opt-out option through an alternative specific constant

If we are not only interested in how an opt-out option affects the valuation of the real attributes but also in the value of opting out per se, then a solution is to include one or more alternative specific constants for the opt-out alternative. An alternative specific constant will explain the effects not included in the original attributes – the average effect of omitted variables (Louviere et al. 2000). Furthermore Louviere *et al*. (2000)

argue that models without an alternative specific constant will not predict well in an existing market because it is not possible to include and identify all explanatory variables, which then are caught in the alternative specific constant. An ASC is also used by Paulrud & Laitila 2004, Kontoleon & Yabe 2003, Ruby et al. 1998.

An alternative specific constant explains the remaining effects (and/or the 'noise') not explained by the identified attributes. In particular, as breeding methods and campylobacter levels are not the most important factors in consumer's choice of chicken product, we need some way to confine 'the remaining determinants of choice of chicken' in order to capture noise that is not related to the attributes we are interested in. This can be done by including an ASC. The direct interpretation of this variable is, the respondents' utility for not buying any of the two chickens presented in the choice set (Louviere et al. 2000). A negative ASC parameter indicates that the respondents have preferences for the two alternatives, and therefore do not obtain utility from opting out of the 'game'.

Using an alternative specific constant to capture the opt-out value however, does not solve the problem that we do not know what the respondents opt-out to, due to the formulation of the opt-out alternative we chose in the choice experiment ("non of these"). In particular, we are interested in what values of campylobacter and animal welfare attributes and prices the respondents opt-out to – in this respect, the alternative specific constant is not precise enough to provide values of the opt-out option.

By including both the ASC and an explicit opt-out option, we hope to provide a model where the effects of each factor can be identified with as little noise as possible – because the ASC captures the explanatory power that is not explained by the attributes – neither in the two real choices nor in the opt-out option. First, we model the opt-out values as zero'es and then as personal opt-out values.

ASC and zero valued opt-out

Table E3 shows the results of the estimation procedure when an ASC is included and the opt-out option is modelled as zeros. The effect of including an ASC can be seen by comparing Table E1 with Table E3. Table E3 shows that the LRI improves from around 0.2 to 0,27 in relation to the model presented in table E1, which indicates a better model fit when the ASC and zero opt-out values are used.

Table E.3. Estimation using ASC and zero values for the opt-out for the separate data sets with and without information

Sample A	Without campylobacter information		With campylobacter information	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,5900000	0,0326000	0,6174000	0,0326000
Campylobacterfree	0,7972000	0,0342000	0,6942000	0,0335000
Price	-0,0290000	0,0010790	-0,0288000	0,0010500
Alternative Specific Constant (ASC)	-2,0210000	0,1483000	-2,2658000	0,1785000
LRI	**0,2754**		**0,2765**	
N	**4720**		**4720**	
Log L	**-3.757**		**-3.752**	
Sample B	**Without animal welfare information**		**With animal welfare information**	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,6394000	0,0340000	1,1361000	0,0377000
Campylobacterfree	0,7076000	0,0340000	0,6559000	0,0364000
Price	-0,0287000	0,0010700	-0,0232000	0,0011100
Alternative Specific Constant (ASC)	-2,0303000	0,1529000	-1,3171000	0,1792000
LRI	**0,2704**		**0,2756**	
N	**4484**		**4484**	
Log L	**-3.594**		**-3.569**	

ASC and inclusion of the respondents own (opt-out) values

Table E4 shows the results of the estimation procedure when an ASC is included and the opt-out option is modelled as personal values. The effect of including an ASC can be seen by comparing Table E4 with Table E2. The fit of the different models are not much different depending on how the opt-out values are computed – they vary from 0.20 without the ASC to around 0.27 with the ASC. Hence, because of the reasonable assumption behind the argument presented by Ruby et al. (1998), and because of the slightly increased fit of the model, the respondents 'own' opt-out values, an ASC are incorporated in the modelling and estimation procedures.

The direct interpretation of the ASC is, the respondents' utility for not buying any of the two chickens presented in the choice set (Louviere et al. 2000). The ASC parameter is negative, indicating that the respondents have preferences for the two alternatives, and therefore do not wish to opt-out from the 'game'.

Table E.4. Results from the estimation procedure using the respondents "own" opt-out values and an ASC for the separate data sets with and without information

Sample A	Without campylobacter information		With campylobacter information	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,5822000	0,0330000	0,6072000	0,0325000
Campylobacterfree	0,7655000	0,0354000	0,6718000	0,0340000
Price	-0,0309000	0,0010710	-0,0302000	0,0010370
Alternative Specific Constant (ASC)	-1,8888000	0,2045000	-1,7888000	0,1981000
LRI	**0,2683**		**0,2767**	
N	**4720**		**4720**	
Log L	**-3.794**		**-3.751**	
Sample B	**Without breeding information**		**With breeding information**	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,6396000	0,0338000	1,1248000	0,0385000
Campylobacterfree	0,6822000	0,0349000	0,6582000	0,0377000
Price	-0,0300000	0,0010630	-0,0259000	0,0010750
Alternative Specific Constant (ASC)	-1,4560000	0,1603000	-1,8900000	0,2932000
LRI	**0,2696**		**0,2725**	
N	**4484**		**4484**	
Log L	**-3.598**		**-3.584**	

In Table E5, the two datasets are merged according to appendix F. As the final model in Table E5 shows the disutility of opting out decreases when respondents receive breeding information. When merging the two datasets the effect of an ASC becomes visible.

Table E.5. Comparison of the probit model with and without alternative specific constants (ASC) and with individual opt-out values

	With an ASC		Without an ASC	
Choice	**Coefficients**	**Std. Err**	**Coefficients**	**Std. Err**
Outdoor bred	0,398700	0,044100	0,5284000	0,0196000
Outdoor bred (with breeding information)	0,488900	0,038900	0,2526000	0,0268000
Campylobacter-free	0,482100	0,043700	0,5102000	0,0186000
Campylobacter-free (with breeding information)	-	-	-	-
Outdoor bred AND campylobacter-free	0,425300	0,079900	0,0758000	0,0275000
Outdoor bred AND campylobacter-free (with breeding information)	-	-	-	-
Price	-0,030400	0,000591	-0,017400	0,000304
Price (information regarding breeding method given)	0,004620	0,001050	ns	-
Alternative Specific Constant (ASC)	-1,865300	0,106000	-	-
ASC (information regarding breeding method given)	0,506300	0,062700	-	-
STD(opt-out)	2,068400	0,104000	0,000105	-
LRI	0,2719		0,2211	
N	55224		55224	
Log L	-14725		-15751	

As can be seen from the above table E5, the model without alternative specific constants is quit different from the model with constants. The price parameter with information regarding the breeding method is no longer significant, when the alternative specific constants are not included. If we take a closer look at the coefficients of the parameters, they show something else. The utility of the animal welfare - and the campylobacter attributes increases when the ASC is omitted, and at the same time the respondents' gets less price sensitive, which leads to an increase in the willingness to pay estimates for the to main effects. The reason for these changes in the utility is partly due to a positive correlation between the price attribute and the alternative specific constant which is 0,442. This positive correlation describes that the proportion of disutility by opting out which is not caught in the other attributes is partly depending on the price. So when the alternative specific constant is removed, the expression no longer takes the disutility of opting out into account or the extra utility you obtain just by choosing one of the generic alternatives. Because the alternative specific constant is correlated with the price attribute, the utility of choosing one of the generic alternatives is expressed through the price attribute, resulting in the less elastic price coefficient. Moreover the log-likelihood drops resulting in a 20% decrease in the LRI. This indicates that the models are better explained when an alternative specific constant is included.

Appendix F: Merging data sets – test for scaling

To test whether the two samples are alike, a scaling test is completed. This furthermore gives a tool to correct for a possible scaling effect. A scaling effect occurs because the models may reflect different underlying scales (Ruby et al. 1998) (We recall that only the joint samples are intended to be sent out to a representative part of the population – hence, there is a risk that the samples A and B are not representative individually). In our analysis, the scaling issue is of concern when we want to merge effects that are not significantly different. That is, as campylobacter information does not significantly change the values of the attributes, we want to merge the data sets A1 and A2. And, as we expect that samples without information A1 and B1 are identical, we want to merge these too.

The basis for a scaling test is taken in the following probability models:

$$1)\ \text{Prob}\left(x\right)_1 = \beta_1 y + \varepsilon_i = \beta_1^* / \sigma_1 + \varepsilon_i$$

$$2)\ \text{Prob}\left(x\right)_2 = \beta_2 y + \varepsilon_i = \beta_2^* / \sigma_2 + \varepsilon_i$$

The coefficients (β) in the econometric models are usually expressed in their scaled form $\left(\beta = \beta^* / \sigma\right)$, where the scale parameter σ and the 'original' coefficients β^* cannot be separately identified (Train 2003). The estimated parameter β indicate the effect of each observed variable relative to the variance of the unobserved factors (Train 2003). But the scale parameter does not affect the ratio of different coefficients, because it drops out: $\beta_1 / \beta_2 = \left(\beta_1^* / \sigma\right) / \left(\beta_2^* / \sigma\right) = \beta_1^* / \beta_2^*$, hence when comparing willingness to pay estimates from different samples the scaling issue is of no concern (Train 2003).

To test for scaling, the scale factor differences have to be isolated before comparing the parameters. The problem is though, that the scaling factor cannot be identified in any particular set of empirical data. But instead the ratio of the scale factor of one data set relative to another can be identified by normalizing one of them to the value of 1 and then defining a range of values of the other scale factor, within which we expect the log likelihood function to be maximized (Swait & Louviere 1993). Because of this, the variance differences are estimated under the assumption of parameter

equality, followed by testing the assumption of equality of the parameters. In general we wish to test the following hypothesis:

$$H_1 : \beta_1 = \beta_2 \text{ and } \sigma_1 = \sigma_2$$

This can be done using a two stage Chow test:

$$\text{A) } H_{1A} : \beta_1 = \beta_2 = \beta$$
$$\text{B) } H_{1B} : \sigma_1 = \sigma_2 = \sigma$$

During the test of hypothesis A) the scale factors are permitted to differ between data sets. If A) cannot be rejected, hypothesis H_{1B} is tested. Both sub-hypotheses can be tested using the following likelihood ratio statistics:

$$\text{Re. A) } \lambda_A = -2\left[L_\sigma - \left(L_1 + L_2\right)\right]$$
$$\text{Re. B) } \lambda_B = -2\left[L_p - L_\sigma\right]$$

Where the L_σ is the log likelihood value corresponding to the model with the point estimate σ_2 value and L_1 and L_2 correspond to the log likelihood values for the separate models for sample 1 and 2. The L_p correspond to the log likelihood value for the joined model for sample 1 and 2 without taken any notice of the scale factors. The sub-hypothesis A) is tested with (k+1) degrees of freedom, where k is the total number of parameters in each model (for sample 1 and 2). The sub-hypothesis B) is tested with only one degree of freedom (the test statistic is asymptotically chi-squared distributed). Below the two hypotheses are tested using both a conditional logit model and a multinomial probit model. The datasets, which are to be joined, are the campylobacter split with - and without information (table F1) and the two splits: 'campylobacter information' and 'animal welfare information'. For the last mentioned dataset, it is only the data before the information was given, which we will join with the other split (table F2).

Table F.1. Log likelihood values for the models with and without campylobacter information and the results of the hypothesis tests using a multinomial probit model

L_σ	L_1	L_2	λ_A	sig.	L_p	λ_B	sig
-7548,5501	-3793,9569	-3750,7161	7,7542	**Ns**	-7549,2059	1,3115	**ns**

Because both hypotheses cannot be rejected (A and B), the overall hypothesis can also not be rejected, and the two data sets A1 and A2 can be joined without worrying about scaling.

Table F.2. Log likelihood values for the models for campylobacter (with - and without information) and for animal welfare without information and the results of the hypothesis tests using a multinomial probit model

L_σ	L_1	L_2	λ_A	sig.	L_p	λ_B	sig
-11150,6229	-7549,2059	-3597,9244	6,9851	**Ns**	-11151,1400	1,0343	**ns**

Because both hypotheses cannot be rejected (A and B), the overall hypothesis can also not be rejected, and the two samples A1 and B1 (Campylobacter information and breeding information – before the information was given) - can be joined without worrying about scaling.

Appendix G: Choice of econometric model

The choice of econometric model is of great importance, due to the different underlying assumptions and characteristics in the different models. We have tested how well our data could be fitted with the typical models used in discrete choice modelling (multinomial logit, nested logit, mixed logit, and probit). In section G1, the models are presented and described briefly. In section G2, the different econometric models are used to estimate the parameters in our case study, ending up with an evaluation of the respective models. Finally in section G3, the efficiency of the chosen model is evaluated with respect to the optimal number of repetitions when simulating the probabilities.

G1. Description of econometric models

Standard logit models

Multinomial logit

In general, the standard logit models (binary, conditional, and nested) are characterised by random components that are independent identically distributed (iid) following a Gumbel or type 1 extreme value distribution. In a binary choice situation, where the error terms are iid extreme value distributed, we can easily find the choice probability as the difference between two extreme value variables is distributed logistic (Train, 2003, p. 39). As the choice probabilities are independent, the formal closed form expression of the logit probability that individual *i* chooses alternative *n* between J alternatives is given as:

$$P_{ni} = \frac{e^{V_{ni}}}{\sum_{j=1}^{J} e^{V_{nj}}} \quad \text{(Choice probability for conditional logit model)(G1)}$$

There are several limitations linked to the conditional logit model. First, the conditional logit model can only incorporate taste variations with respect to observed variables (as observations linked to demographic characteristics), but not taste variations connected to unobserved variables (as taste variation just because people have different preferences), see Train (2003). Second, the conditional logit model assumes proportional substitution across alternatives, when a new alternative is introduced. This leads to the property of Independence from Irrelevant Alternatives (IIA). The property of the IIA can be illustrated by the ratio of the logit probabilities of alternative *i* and *k*:

$$\frac{P_{ni}}{P_{nk}} = \left(e^{V_{ni}} \Big/ \sum_j e^{V_{nj}} \right) \Big/ \left(e^{V_{nk}} \Big/ \sum_j e^{V_{nj}} \right)$$

$$= \frac{e^{V_{ni}}}{e^{V_{nk}}}$$

$$= e^{V_{ni} - V_{nk}} \qquad \text{(G2)}$$

As seen in the above equation, the probability ratio only depends on alternative *i* and *k*. That is, the relative probability of two options being selected are unaffected by the introduction or removal of other alternatives (Train, 2003; Alvarez & Nagler, 1998).

Finally, the conditional logit model assumes no correlations of unobserved factors over time. This can be a severe assumption if there are dynamics in the observed factors, then there might be expected to dynamics in the unobserved factors as well (Train, 2003). In particular it means that standard logit models cannot be used to analyse panel data when unobserved factors are correlated over time (Train, 2003, p. 101).

Once the parameter estimates have been obtained (using a maximum likelihood procedure), the willingness to pay estimate can be derived. For the linear model, the willingness to pay is obtained using the following equation (Parsons & Kealy, 1992).

$$WTP = \frac{1}{\beta_p} \times \ln\left(\frac{\sum_i \exp(V_{in})}{\sum_i \exp(V_{is})} \right) = \frac{-(V_{in} - V_{is})}{\beta_p} = \frac{-\beta_n}{\beta_p} \qquad \text{(G3)}$$

Consider a choice situation with more than 3 alternatives. If all alternatives are included simultaneously in the decision making and if the choice between alternative is not affected by introduction of additional alternatives, then a conditional logit is appropriate. Let us consider our choice experiment where respondents are faced with choice sets that include real alternatives and an opt-out alternative. If the respondent's decision to opt-out depends on the attractiveness of the real alternatives then the three alternatives are to be considered as alternatives with equal substitution and a conditional logit model can be used (Lauridsen 2005).

Multinomial logit models are used to analyse the value of changes in the length of deer hunting seasons in Schwabe et al. (2001) and for estimating recreational values in Hanley et al. (2002).

Nested logit

A nested logit model is appropriate when the set of alternatives faced by a decision maker can be partitioned into subsets, called *nests* (Train, 1986). This model is based on the assumption of sequential decision-making. Consider a choice experiment where respondents are faced with choice sets that include an opt-out alternative. If respondents choose their most preferred alternative using a two-step decision rule, i.e first, they decide whether to 'opt-in' or 'opt-out', and next, given that opt-in was the chosen nest, the respondents make a choice between the 'real' alternatives, this is called a nested process. If the respondents follow this sequential decision rule, then the specific composition of the 'real' alternatives has no influence for the choice between opt-in and opt-out (Lauridsen, 2005).An advantage of the nested model is that the zeros of the opt-out attributes are no longer treated as real levels, because they now are captured in a different nest (Haaijer *et al,*. 2001). This has the important implication that the specific modelling of the opt-out alternative does not influence the marginal utility estimates of the attributes in the 'real' alternatives.

Another advantage of the nested logit model is that the assumption regarding the IIA is not exhibited between the nests, but only within each nest (Train, 2003). That is within a nest, the nested logit models require unchanged proportional substitutions between alternatives when additional alternatives are introduced. However, the nested logit model can capture a situation where substitutions between nests are affected by introduction of other alternatives.

The nested logit model is limited by the same restriction as the conditional and binary logit models in that it can only incorporate taste variations with respect to observed variables (Train, 2003).

In reality, the researcher typically does not know whether the respondents apply the above mentioned sequential decision rule so the argumentation should rather be turned upside down: If the researcher has some indications that a sequential decision rule is applied (maybe through focus group interviews or previous analyses) or if the econometric analyses show that nested logit provides the best data fit – then the researcher can conclude that the decision structure is sequential.

The choice probability of individual *n* choosing alternative *i* in nest *k* using a nested logit model can be formally written (in a closed form) as

$$P_{ni} = \frac{e^{V_{ni}/\lambda_k}\left(\sum_{j\in B_k} e^{V_{nj}/\lambda_k}\right)^{\lambda_k - 1}}{\sum_{l=1}^{K}\left(\sum_{j\in B_l} e^{V_{nj}/\lambda_l}\right)^{\lambda_l}}$$

(Choice probability for a nested logit model) (G4)

where k=1,.. , K defines nests B_1,…….,B_K
λ_k defines the degree of independence in unobserved utility among alternatives in nest k
V_{nj} is the observed utility for individual *n* by choosing alternative *j*

Multinomial probit (MNP)

The probit models are characterised a normally distributed error term as opposed to the logit models Gumbel distributed error term. The probit models have yet not been used that often because of the computational requirements during the simulations process, even though they have existed since the late 1920s (Thurstone 1927). Hausman & Wise (1978) introduces the general specifications and aspects of choice behaviour in relation to the probit model described by Thurstone (1927).

The multinomial probit model is an extension of the binary probit model, which can handle multiple choices as well. The multinomial probit model relaxes all the restriction mentioned in chapter 3 – it allows taste variations, correlation of unobserved factors over time and the IIA property. The relaxation of the IIA property is caused by the multinomial probit model's ability to allow for correlation between the error terms for the different choices (Alvarez & Nagler, 1998). This makes it a very attractable model (as also the mixed logit model). Train (2003) argues that the only limitation of the model is that all the unobserved components are assumed normal distributed. But as mentioned above there are some computational challenges because the choice probability is an integral with an open form, which has to be estimated through simulation (Train, 2003).

$$P_{ni} = \int I\left(V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}\,\forall j \neq i\right)\phi\left(\varepsilon_n\right)d\varepsilon_n$$

(Choice probability for a probit model) (G5)

Where

- I: an indicator for whether the statement in parentheses holds
- ε_{ni} : the unobserved part of the utility for individual i by choosing alternative n
- $\Phi(\varepsilon_n)$: The normal density of ε_n

A probit model is used in Bolduc (1999) to model the choice of transport to the morning peak journey to work in Santiago. For further reading regarding the probit model see Munizaga & Alvares-Daziano (2001), Nijkamp et al. (2004), Ben-Akiva et al. (1997), Bolduc et al. (1996) and Chen & Cosslett (1998).

Mixed logit models

The main characteristic of the model is that the researcher can specify the distribution of the different variables and their error-components. Therefore, the mixed logit model can approximate any random utility model (McFadden & Train, 2000).The mixed logit model is a mixture of different models, but with starting point in the conditional logit model (Brownstone & Train, 1999). In example, the mix could be of the conditional logit model and the multinomial probit model.

The term mixed logit stems from the statistics literature, where the weighted average of several functions is called a mixed function, and the density that provides the weights is called the mixing distribution. Mixed logit is a mixture of the logit function evaluated at different β's with f(β) as the mixing distribution (Train, 2003, p. 139). That is, a mixed logit model is any model whose choice probabilities can be expressed as

$$P_{ni} = \int L_{ni}(\beta) f(\beta) d\beta \qquad \text{(G6)}$$

where $L_{ni}(\beta)$ is the logit probability for a given parameter value β and f(β) is a density function for the parameters. Assuming as above that utility is linear in attributes, the mixed logit choice probability can be written as

$$P_{ni} = \int \left(\frac{e^{\beta' x_{ni}}}{\sum_j e^{\beta' x_{nj}}} \right) f(\beta) d\beta \quad \text{(Choice probability for a mixed logit model)} \qquad \text{(G7)}$$

Where

- x_{ni} is a vector of observed variables relating to alternative i and the observed part of the utility for individual *n* by choosing alternative *i* $V_{ni} = \beta' x_{ni}$
- f(β) can be any density function

Mixed logit can be derived under a variety of behavioural assumptions – each derivation provides a particular interpretation (Train, 2003, p. 138). A random coefficient model (or random parameter logit) is used to describe a model where the mixing relates to the factors whereas a mixed logit with error component is used to describe a model where mixing is related to the error terms.

The mixed logit model averts the three limitations of the conditional logit model, by allowing for taste variation, correlation over time and relaxation of the property of the IIA. Hence, the mixed logit model has many advantages. The only disadvantage of the mixed logit model is that it is based on Monte Carlo simulation methods (Ben-Akiva & Lerman, 1985), which can be very time consuming due to the computational challenge of the simulation (SAS, 2005).

Examples of random parameter logit models (mixed logit) can be found in Train (1998) where mixed logit is used to evaluate anglers' choice of fishing sites, in Paulrud & Laitila (2004) mixed logit is used to analyse anglers' preferences for the attributes of the Kaitum River in Sweden; and in Carlsson et al. (2003b) mixed logit is used to value wetland attributes.

G2. Underlying probability structure

Which of the econometric models to use, depends on the statistical fit of the models, the underlying decision structure and, whether or not the property of the Independence from Irrelevant Alternatives exits in the data set? The tests of which econometric model to use, are performed in the joined dataset (A and B) with attributes with and without information about breeding method (where the attributes without breeding information includes no information and information regarding campylobacter). The 'fit' criterion presented by Louviere et al. (2000), states that a likelihood ratio index (LRI) between 0.1 and 0.2 indicates an acceptable model, whereas a fit between 0,2 and 0,4 is an indicator of a model with an extremely good fit.

Estimation with nested logit

In the following estimation procedure the nested logit model is used. Furthermore the attributes are coded as dummy variables (as shown in Figure D1, appendix D), and the respondents 'own' opt-out values are included. Table G1 shows the statistical estimations using nested logit.

Table G1. Estimation using nested logit and the respondents 'own' opt-out values (dummy coded)

Choice	Coefficients	Std. Err	P-value
Outdoor bred	0,727685	0,022352	0,000
Outdoor bred (with breeding information)	0,524307	0,043991	0,000
Campylobacter-free	0,874157	0,021424	0,000
Campylobacter-free (with information)	-0,156403	0,043351	0,001
Price	-0,038984	0,000705	0,000
Price (with breeding information)	0,008499	0,001328	0,000
LRI	**0,2604**		
N	**18408**		
Log L	**-14957**		

Estimation with conditional logit

The conditional logit model gives a reasonable Likelihood Ratio Index, and the signs of the coefficients are all as expected. The statistical estimations using conditional logit model is shown in Table G2.

Table G2. Estimation using conditional logit and the respondents 'own' opt-out values (dummy coded)

Choice	Coefficients	Std. Err	P-value
Outdoor bred	0,677774	0,020614	0,000
Outdoor bred (with breeding information)	0,518908	0,043991	0,000
Campylobacter-free	0,793565	0,021424	0,000
Campylobacter-free (with breeding information)	-0,115004	0,043351	0,008
Price	-0,035878	0,000705	0,000
Price (with breeding information)	0,006582	0,001328	0,000
ASC	-1,240270	0,032713	0,000
ASC (without breeding information)	0,123141	0,053270	0,021
ASC (with breeding information)	0,501011	0,055401	0,000
LRI	**0,2677**		
N	**18408**		
Log L	**-14809**		

Note: ASC is an alternative specific constant. with or without campylobacter information

Comparing G1 and G2, reveals that the estimated coefficients from nested logit and conditional logit are very much alike. The nested logit model gives a little lower Likelihood Ratio Index than the conditional logit model.

Estimation with mixed logit

A mixed logit model can be defined with different distributions for different parameters and their error components. We tried to fit our data with lognormal as well as normal distributions for parameters and error components.

Table G3. Results from the estimation procedure using mixed logit and the respondents 'own' opt-out values (dummy coded). The price parameter without breeding information is normally distributed, while the rest are gumbel distributed.

Choice	Coefficients	Std. Err	P-value
MEAN			
Outdoor bred	0,733900	0,022700	<,0001
Outdoor bred (with breeding information)	0,561800	0,047000	<,0001
Campylobacter-free	0,900500	0,024900	<,0001
Campylobacter-free (with breeding information)	-0,121600	0,046900	0,010
Price	-0,042600	0,001026	<,0001
Price (with breeding information)	0,007811	0,001521	<,0001
ASC	-1,367200	0,036900	<,0001
ASC (without breeding information)	0,140800	0,057100	0,014
ASC (with breeding information)	0,556400	0,059200	<,0001
STD. DEV. OF COEFFICIENTS			
Price	0,025100	0,001477	<,0001
LRI	**0,2709**		
N	**18408**		
Log L	**-14745**		

Note: ASC is an alternative specific constant. with or without campylobacter information

The parameters in Table G3 are divided into two parts – 'Mean' and 'Standard Deviation'. The 'Standard Deviation' WTP estimates can be interpreted as the variation in marginal utilities (and willingness to pay) in the population (Revelt & Train, 1998).). In table G4 the distributions are reversed compared to the model in table G3. Therefore, the parameters in the next model are all normally distributed with the exception of the price attributes and the opt-out variables which are Gumbel distributed.

Table G4. Estimation using mixed logit and the respondents 'own' opt-out values (dummy coded). The price parameters and the opt-out variables are gumbel distributed , the other parameters are normally distributed.

Choice	Coefficients	Std. Err	P-value
MEAN			
Outdoor bred	0,677800	0,020600	<,0001
Outdoor bred (with breeding information)	0,519300	0,044000	<,0001
Campylobacter-free	0,793600	0,021400	<,0001
Campylobacter-free (with breeding information)	-0,114800	0,043400	0,008
Price	-0,035900	0,000705	<,0001
Price (with breeding information)	0,006573	0,001329	<,0001
ASC	-1,240200	0,032700	<,0001
ASC (without breeding information)	0,123100	0,053300	0,021
ASC (with breeding information)	0,500900	0,055400	<,0001
STD. DEV. OF COEFFICIENTS			
Outdoor bred	-0,016000	0,078100	0,838
Outdoor bred (with breeding information)	0,020900	0,149300	0,889
Campylobacter-free	-0,013600	0,054600	0,803
Campylobacter-free (with breeding information)	0,038600	0,109300	0,724
Price	-	-	-
Price (with breeding information)	-	-	-
LRI	**0,2677**		
N	**55224**		
Log L	**-14809**		

Note: ASC is an alternative specific constant. with or without campylobacter information

The price parameter is significant, but as can be seen, the standard deviations of the normal distributed parameters are all insignificant, which indicates that there is no taste variation between individuals.

Assuming that parameters are normally distributed implies that some estimated share of the population has positive coefficients for the given parameters and some have negative coefficients. In particular, the price parameter is assumed to be normally distributed in G3. Hence, some respondents have positive coefficients for the price parameter, which seems quite unrealistic. A solution to the above problems with the estimates from the different mixed logit models can be to define the price parameters to be log-normally distributed. Thereby, by definition the price parameters can not be negative (Train 2003). The rational for doing this is that we assume the sign of the price parameter to be the same for all respondents (Train, 2003). Since the log-normal distribution is defined over the positive range and price is expected to have a negative coefficient for all respondents, the negative of price enters the model (Train 2003) and we try to redefine the price variable just with inverse signs.

The parameters in the log-normal distribution for β include the mean (b) and standard deviation (s) of the log(β). Because of this the estimates have to be converted so they are on the 'pure' β-form. This is done the following way: Median: $\exp(b)$, mean: $\exp\left(b + \left(s^2/2\right)\right)$ and standard deviation: $mean \times \sqrt{\exp\left(s^2\right) - 1}$ (Revelt & Train 1998). Table G5 shows the statistical estimation of mixed logit using a lognormal distribution for the price parameter. The coefficients in the table are converted from the log (β) to β in order to be interpretable as coefficients for β.

Table G5. Results from the estimation procedure using mixed logit and the respondents 'own' opt-out values (dummy coded). The price parameters are re-signed and log-normally distributed.

Choice	Coefficients	Std. Err	P-value
Outdoor bred	5,554900	0,185900	<,0001
Outdoor bred (with breeding information)	4,011400	0,130400	<,0001
Campylobacter-free	6,286900	0,181700	<,0001
Campylobacter-free (with breeding information)	-	-	-
Price	0,382580	0,000000	<,0001
Price (with breeding information)	0,401979	0,250496	<,0001
ASC	-2,886300	0,000000	<,0001
ASC (with breeding information)	1,501400	0,000000	0,014
LRI	.		
N	18408		
Log L	-36743		

Note: ASC is an alternative specific constant. with or without campylobacter information
The Price coefficients are converted from log- to non-log, which is why there are no standard deviation.

As the above table shows, the coefficients values change dramatically when using the log-normal distribution of the price parameters. Remember that the price parameters are re-signed which explains the positive sign of the parameters. Even though the parameters are strongly significant, the overall fit of the model is very poor. The maximum log-likelihood value for this model is below the initial log-likelihood value (L_0). This gives a Likelihood Ratio Index below zero, which is outside the definition of the ratio, which must lie between 0 and 1 (Ben-Akiva & Lerman, 1985).

Estimation with multinomial probit

The multinomial probit model has a normally distributed error component and does not exhibit the IIA. In the following model the first and the second choices are normalized, which imposes an additional restriction that the following correlation parameters are zero ($\rho_{32} = \rho_{21} = 0$). Furthermore the covariance matrix is specified from the Hessian matrix.

Table G6. Results from the estimation procedure using a multinomial probit model and the respondents 'own' opt-out values (dummy coded).

Choice	Coefficients	Std. Err	P-value
Outdoor bred	0,612300	0,019000	0,000
Outdoor bred (information regarding breeding method given)	0,490000	0,039100	0,000
Campylobacter-free	0,696600	0,017700	0,000
Campylobacter-free (information regarding breeding method given)			
Price	-0,030500	0,000591	0,000
Price (information regarding breeding method given)	0,004737	0,001055	0,000
Alternative Specific Constant (ASC)	-1,880500	0,108200	0,000
ASC (information regarding breeding method given)	0,509500	0,063700	0,000
STD(opt-out)	2,117900	0,107100	0,000
LRI	0,2711		
N	18408		
Log L	-14741		

As can be seen from the above table G6 for the multinomial probit estimates, the estimates looks reasonable. The signs are as expected. Furthermore the likelihood ratio index is higher then any of the other estimated models. The same parameters are significant as in the other models, except from the parameter for campylobacter-free after breeding information was given, which is insignificant.

This means that using a probit model, the willingness to pay for avoiding campylobacter is not affected directly by information regarding breeding methods, but only indirectly through the change in price sensitivity. Whereas using a nested or conditional or mixed logit, the breeding information does influence the willingness to pay for avoiding campylobacter. As there are no intuitive arguments for why the willingness to pay for avoiding campylobacter should be affected by information given regarding animal welfare. So from this point of view, the insignificance of this attribute is acceptable.

Based on the 'fit' criterion, the mixed model with a log-normally distributed price parameters is clearly excluded. The rest of the presented models all have acceptable fits.

Underlying decision structure

The next criterion is related to the decision structure of the underlying model. In the section regarding the econometric model, the different decision structures are described. It all depends on when the respondent decides to opt-out – is it before he/she examines the characteristics of the two other alternatives/products, or is it after.

The decision structure implicitly assumed in a nested logit model is that the consumer performs a sequential choice: First, the consumer chooses whether to opt-out or not, and second, if the consumer chooses to buy a chicken, then characteristics of the two real alternatives are considered. The conditional logit model on the other hand, implicitly assumes that the consumer decides whether to opt-out after looking at the characteristics of the two real alternatives. If the consumers opt-out in our choice experiment, then they might opt-out to their normal chicken product. This indicates the choice task involves 3 similar products and therefore they opt-out because of the characteristics of the two other alternatives. Only 10% of the respondents who have chosen to opt-out do not eat chicken or do not buy the presented chicken product so for the remaining 90% of the respondents, a conditional logit is most appropriate. All together, we find that decision structure assumed in conditional logit provides a better description of the respondents' choice tasks than the nested logit model might do. The mixed logit and the probit models do not place any restrictions on the decision structure so they are both acceptable according to the decision structure criterion.

Independence of irrelevant alternatives

The last criterion depends on whether or not the property of the Independence of Irrelevant Alternatives exits in the data set. To test for this property Hausman & McFadden (1984) suggested that if a subset of the choice set truly was irrelevant with respect to the other alternatives, omitting it from the model would not lead to inconsistent estimates. They used the previous specified Hausman Test to test for IIA (Hausman, 1978).

To complete the test, two different models are estimated – one model which represents the full model including the opt-out alternative – and one model where the opt-out alternative is excluded. The parameter coefficients from these two different models are then compared to each other, and under the IIA assumption they should be a

like (the null hypothesis). If this is not the case, the IIA property is violated. Below in table G7 the results from the Hausman Test are shown.

Figure G7. Results from the completed Hausman Test – using a conditional logit model.

	Coefficients			
	(b)	(B)	(b-B)	Sqrt(diag(V_b-V_B))
Choice	without opt-out	full model	Difference	S.E.
Outdoor bred	0,7288206	0,6777742	0,0510464	0,0106695
Outdoor bred (information regarding breeding method given)	0,6651631	0,5189083	0,1462548	0,0287074
Controlled and labeled campylobacter-free	0,9036810	0,7935647	0,1101164	0,0140782
Controlled and labeled campylobacter-free (information regarding breeding method given)	-0,1029960	-0,115004	0,0120081	0,0310479
Price	-0,0374133	-0,035878	-0,001535	0,0005858
Price (information regarding breeding method given)	0,0074933	0,0065820	0,0009113	0,0010390
chi2(6)	(b-B)'[(V_b-V_B)^(-1)](b-B)			
	135,17			
Prob>chi2	0,0000			

In Table G7, the coefficients from the two models are compared, and the result shows that they are not identical. The very small p-values indicate that the difference between the parameter values is strongly significant, and because of that, that the Independence from Irrelevant Alternatives property is violated. Hence the conditional logit model will give biased estimates, and therefore the remaining models to consider is the mixed logit - and the multinomial probit model. As mentioned above, when using the mixed logit model, the standard deviations of the normal distributed parameters are insignificant, which biases the model. Therefore, the mixed logit model is dropped and *the multinomial probit model is chosen.*

G3. The number of simulations

The probit model is estimated through a number of simulation procedures. These simulation procedures can be quite time consuming, and because of this we have an incentive to make the simulation procedure as efficient as possible by reducing the number of repetitions. When using the PROC MDC in SAS, the default is 200 repetitions/simulations. As can be seen from the below table 21, this takes 7,77 minutes. In the literature different ranges of the number of repetitions are used. Munizaga & Alvarez-Daziano (2001) uses values from the range 5 to 1000 repetitions, whereas Chen and Cosslett (1998) used values from 10 to 2000 repetitions and Brownstone & Train (1999) used respectively 50 and 125 repetitions. The important aspects for the comparison of models estimated by different number of repetitions are CPU time, log-likelihood values and the number of iterations (Munizaga & Alvarez-Daziano 2001). Rendtel & Kaltonborn (2004) shows, that their ML estimation is biased when using 10 repetitions, but when increasing the number of repetitions to 100, the bias decreases considerably. Chen & Cosslett (1998) argues that 2000 repetitions are appropriate. These very different recommendations indicate that it depends on the exact survey, how many repetitions the simulation procedure requires.

Table G8. The final main effect probit model estimated by different number of repetitions (the values in (*italic*) are standard errors to the above variables)*.

	Number of repetitions					
N	**5**	**10**	**25**	**50**	**75**	**100**
Outdoor bred	0,6255	0,6127	0,6149	0,6118	0,6125	0,6123
	(0,0191)	*(0,0191)*	*(0,0190)*	*(0,0190)*	*(0,0190)*	*(0,0190)*
Outdoor bred (information regarding breeding method given)	0,4925	0,4937	0,4905	0,4911	0,4905	0,4900
	(0,0391)	*(0,0392)*	*(0,0391)*	*(0,0391)*	*(0,0391)*	*(0,0391)*
Campylobacter-free	0,7068	0,7005	0,6991	0,6972	0,6968	0,6966
	(0,0177)	*(0,0177)*	*(0,0177)*	*(0,0177)*	*(0,0177)*	*(0,0177)*
Price	-0,0305	-0,0307	-0,0305	-0,0305	-0,0305	-0,0305
	(0,0006)	*(0,0006)*	*(0,0006)*	*(0,0006)*	*(0,0006)*	*(0,0006)*
Price (information regarding breeding method given)	0,0049	0,0048	0,0048	0,0047	0,0047	0,0047
	(0,0011)	*(0,0011)*	*(0,0011)*	*(0,0011)*	*(0,0011)*	*(0,0011)*
Alternative Specific Constant (ASC)	-1,9810	-2,0046	-1,9015	-1,9050	-1,8884	-1,8805
	(0,1152)	*(0,1172)*	*(0,1099)*	*(0,11)*	*(0,1087)*	*(0,1082)*
ASC (information regarding breeding method given)	0,5293	0,5302	0,5139	0,5130	0,5105	0,5095
	(0,0661)	*(0,0668)*	*(0,0642)*	*(0,0643)*	*(0,0639)*	*(0,0637)*
STD(opt-out)	2,2310	2,2477	2,1414	2,1437	2,1258	2,1179
	(0,1135)	*(0,1154)*	*(0,1087)*	*(0,1087)*	*(0,1076)*	*(0,1071)*
N° Iter.	16	18	18	17	18	17
LL	-14720	-14755	-14736	-14745	-14740	-14741
LL0	-20239	-20225	-20224	-20223	-20223	-20223
Real Time	0,3345	0,4862	1,1307	2,0812	3,4107	4,2088
CPU Time	0,2678	0,4710	1,0775	1,9987	3,0553	3,9642
LRI	0,2727	0,2705	0,2714	0,2709	0,2711	0,2711
LR-test	45,365	-24,795	12,907	-5,862	4,849	2,553
sig.	***	***	***	*	*	**ns**

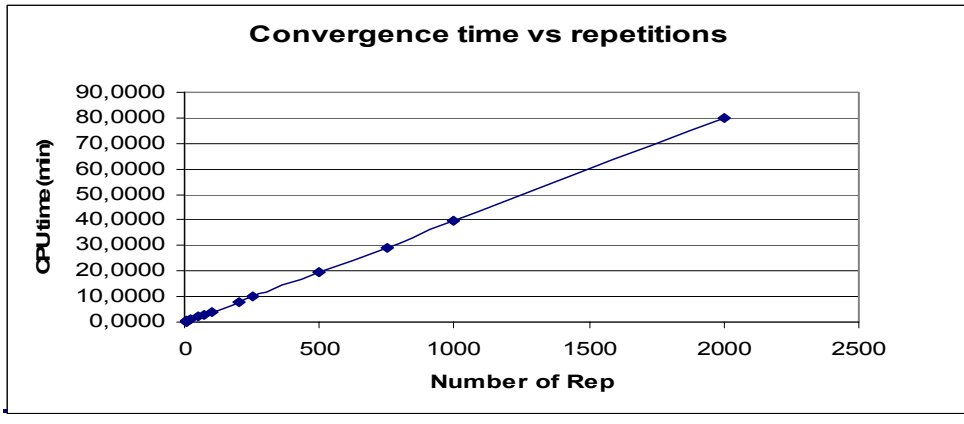
*Note: the attribute “campylobacter-free – with information” is left out due to being insignificant.

Table G8 (continued): The final main effect probit model estimated by different number of repetitions (the values in (*italic*) are standard errors to the above variables).

N	200	250	500	750	1000	2000
Outdoor bred	0,6118 *(0,0190)*	0,6117 *(0,0190)*	0,6118 *(0,0190)*	0,6116 *(0,0190)*	0,6117 *(0,0190)*	0,6117 *(0,0190)*
Outdoor bred (information regarding breeding method given)	0,4901 *(0,0391)*	0,4901 *(0,0391)*	0,4899 *(0,0391)*	0,4899 *(0,0391)*	0,4899 *(0,0391)*	0,4899 *(0,0391)*
Campylobacter-free	0,6966 *(0,0177)*	0,6966 *(0,0177)*	0,6965 *(0,0177)*	0,6964 *(0,0177)*	0,6965 *(0,0177)*	0,6964 *(0,0177)*
Price	-0,0305 *(0,0006)*	-0,0305 *(0,0006)*	-0,0305 *(0,0006)*	-0,0305 *(0,0006)*	-0,0305 *(0,0006)*	-0,0305 *(0,0006)*
Price (information regarding breeding method given)	0,0047 *(0,0011)*	0,0047 *(0,0011)*	0,0047 *(0,0011)*	0,0047 *(0,0011)*	0,0047 *(0,0011)*	0,0047 *(0,0011)*
Alternative Specific Constant (ASC)	-1,8863 *(0,1086)*	-1,8858 *(0,1086)*	-1,8812 *(0,1082)*	-1,8821 *(0,1083)*	-1,8826 *(0,1083)*	-1,8815 *(0,1082)*
ASC (information regarding breeding method given)	0,5103 *(0,0639)*	0,5104 *(0,0638)*	0,5097 *(0,0637)*	0,5098 *(0,0638)*	0,5099 *(0,0638)*	0,5097 *(0,0637)*
STD(opt-out)	2,1238 *(0,1074)*	2,1234 *(0,1074)*	2,1185 *(0,1071)*	2,1195 *(0,1072)*	2,1199 *(0,1072)*	2,1189 *(0,1071)*
N° Iter.	17	17	17	17	17	17
LL	-14743	-14743	-14742	-14743	-14743	-14.742
LL0	-20223	-20223	-20223	-20223	-20223	-20.223
Real Time	8,2067	10,8945	20,9440	30,6612	49,2273	80,9103
CPU Time	7,7692	9,9182	19,7140	29,3307	39,4838	79,9288
LRI	0,2710	0,2710	0,2710	0,2710	0,2710	0,2710
LR-test	-0,506	-0,947	0,596	-0,362	-0,142	-
sig.	**ns**	**ns**	**ns**	**ns**	**ns**	**-**

Table G8 shows the estimates from the maximum likelihood estimation procedure using different number of repetitions in the simulation procedure. The number of iterations is rather stable between 16 to 18. The CPU time range from below one minute up to above one hour, and from figure G1 it shows that the relation between the number of repetitions and the CPU time is linear.

Figure G1. The CPU time as a function of the number of repetitions.



Finally to decide the number of repetitions to use a likelihood ratio test is conducted cf. to Chen & Cosslett (1998). The reference point (log-likelihood) is the log-likelihood value for the estimation with 2000 repetitions. From table G8, it shows that when estimating with 100 repetitions there are no significant difference between the two log-likelihood values. Because of this the most efficient number of repetitions to use during the simulation procedure is 100 repetitions which have been used in the further analyses.